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VOLUME XXVI NUMBER 6

DISEASES

of the

CHEST

OFFICIAL PUBLICATION

AMERICAN COLLEGE CHEST PHYSICIANS

René Laënnec

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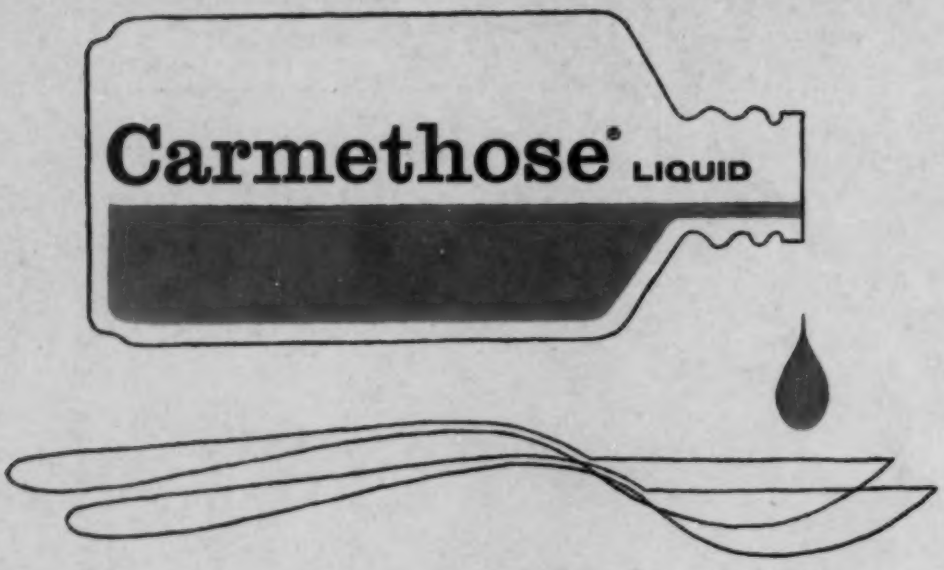

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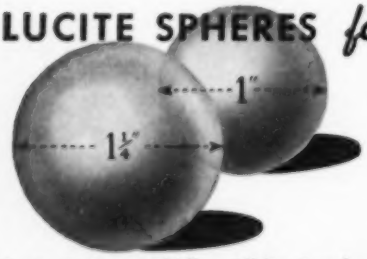

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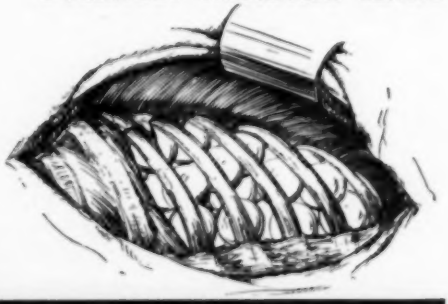

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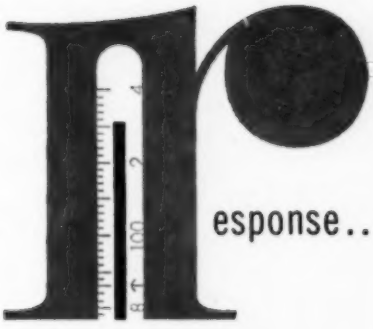

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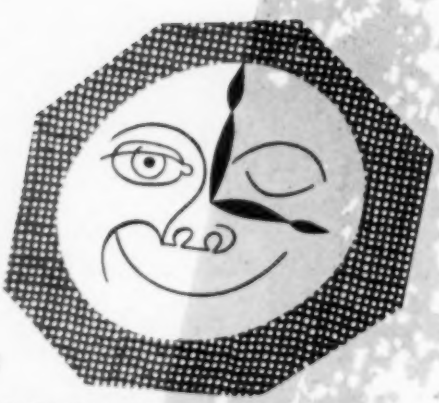

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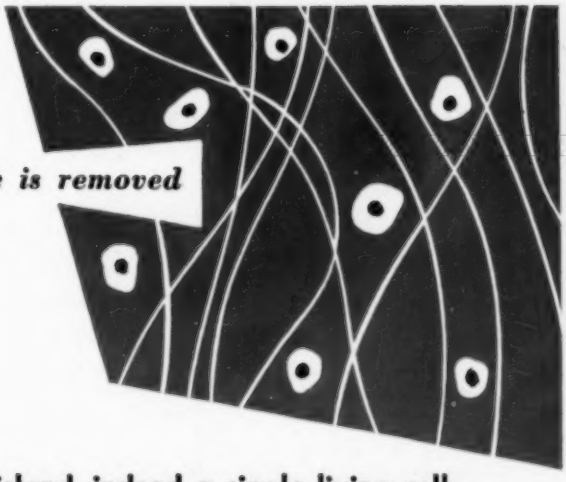

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1. Flippin, H. F.: Postgrad. Med. *14*:6 (July) 1953
2. Flippin, H. F., et al.: J.A.M.A. *147*:918 (Nov. 3) 1951
3. Finberg, L., et al.: Antibiot. & Chem. *3*:353 (April) 1953

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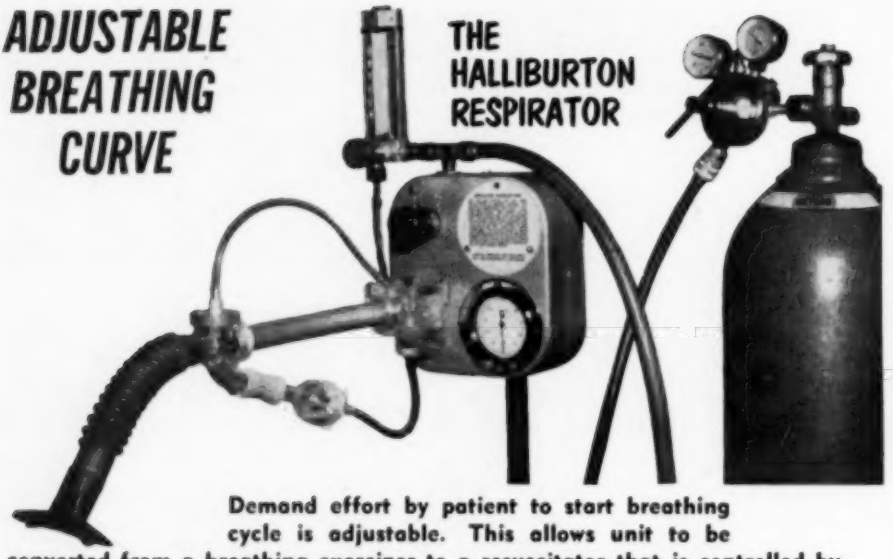

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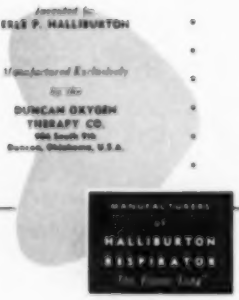

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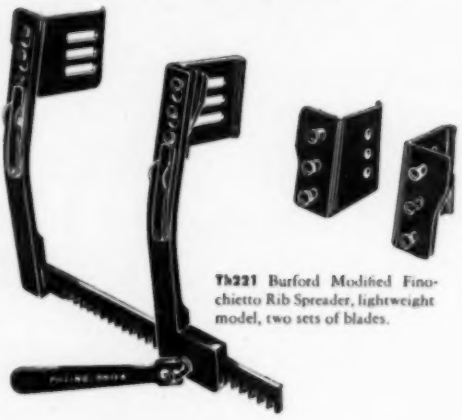

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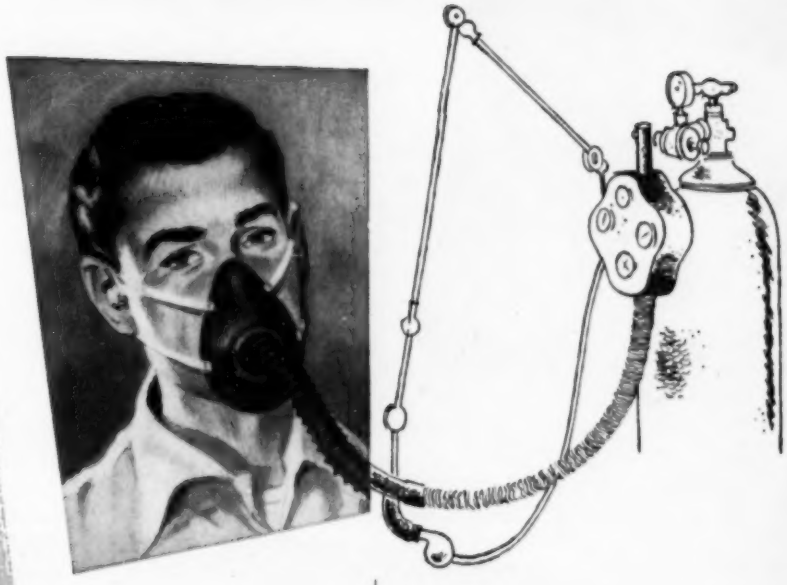

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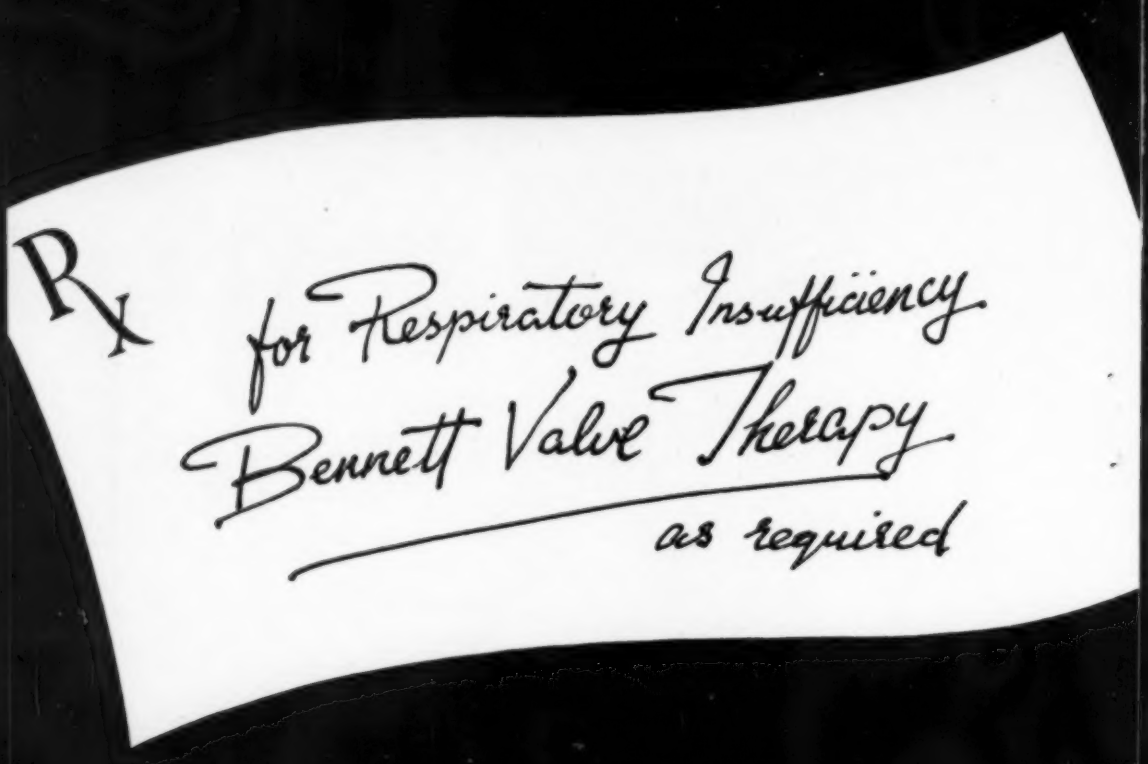

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DISEASES of the CHEST

VOLUME XXVI DECEMBER 1954 NUMBER 6

The Elimination of Tuberculosis from the Midwestern States in the Next Fifty Years

DAVID T. SMITH, M.D.*

Durham, North Carolina

The National Tuberculosis Association was founded fifty years ago, in 1904. At that time the public believed that tuberculosis was inherited and plans for its control utopian dreams. The situation was discouraging. The death rate, in areas where deaths were registered, was nearly 200 per 100,000; with the major part of the deaths in infants and young adults. In the northeastern states nearly 100 per cent of the population had a positive tuberculin test, indicating infections, by the age of 20. There were only a few thousand beds for patients with tuberculosis in the entire United States. The x-ray technique for finding tuberculosis had not been developed and case finding clinics as we know them today were non-existent.[1] There were only two encouraging factors: (1) deaths from tuberculosis had been almost twice as frequent 50 years before (Figure 1) and (2) there was now a new organization which had dedicated itself to the elimination of this dreadful disease.

It is probable that the death rate from tuberculosis in the midwestern states was never as high as in the northeastern states. In the midwest the mass of people had a higher standard of living and were scattered on farms and in small villages where the opportunity for infection was less than in the more crowded northeastern states.

The program for control moved more rapidly in the midwest. By 1920 there were enough sanatorium beds to isolate and treat most of the known active cases. However, many cases were missed when the chief method of diagnosis was the physical examination and the examination of the sputum for tubercle bacilli. More and more active cases have been found as the x-ray method has been perfected and larger segments of the population x-rayed.

There are no accepted criteria for determining when tuberculosis is under control in a given area. I would like to suggest that tuberculosis be considered under control when the death rate is five or less per 100,000 of the population and only 5 per cent or less of the school population have positive tuberculin tests. Wisconsin is approaching this goal of control; the death rate for 1952 being 6.3 and tuberculin tests in school children

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in 1950 only 5 per cent positive.[2] Dr. Helen Dickie found that University of Wisconsin students who have lived all of their lives in Dane County had a 4 per cent positive reaction to tuberculin. The other midwestern states are approaching the status of control.

The Elimination of Tuberculosis

When tuberculosis is under control then we can begin to make plans for its eradication. To consider the crude overall death rate alone is worse than useless because it is actually misleading. We must know the age and sex groups which harbor the remaining reservoirs of infection.[3, 4]

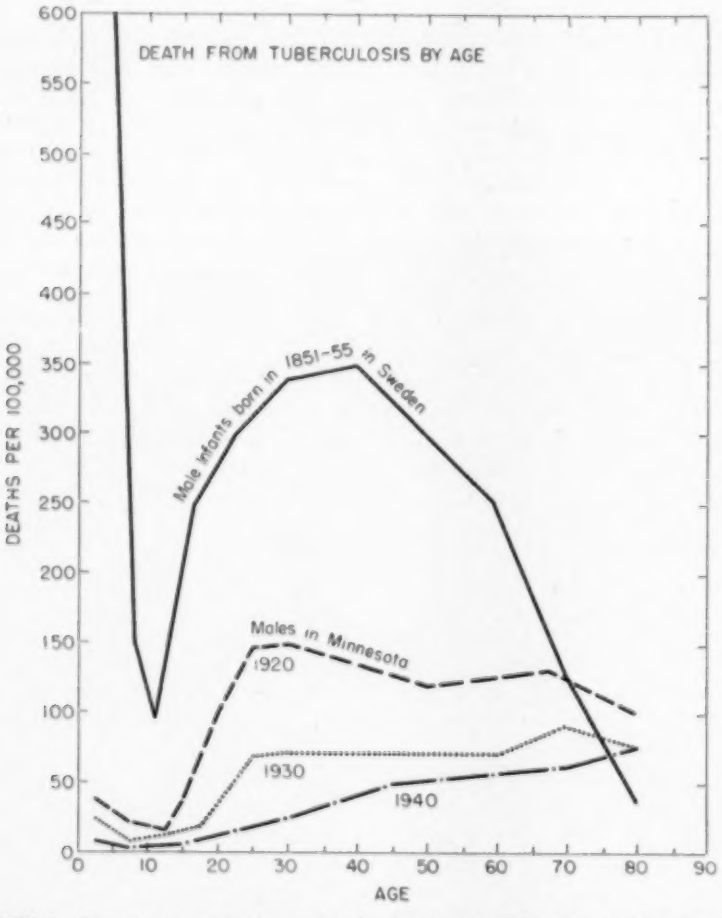

FIGURE 1: The upper curve shows the death rate of males born in Sweden in the years 1851-55 (John B. McDougall, *Tuberculosis*, William and Wilkins Company, Baltimore. Page 218). The lower curves show the death rate in males in Minnesota for the years 1920, 1930 and 1940 (Carroll E. Palmer, U. S. Public Health Service, 1943. Volume 1).

Information of this kind can be obtained from graphs of the type shown in Figures 2 and 3. The death rate for male infants in 1950 was only four and for female infants only two per 100,000. The decline in death rates from 140 in males and 150 in females at the age of 25 in 1920 to a low of four in males and seven in females in 1950 is indeed a dramatic improvement.

The most striking feature of the 1950 curve is the slow steady rise in deaths for men decade by decade from a low of 0.1 at the age of 12 to 61.2 at the age of 75. The death rate for females in 1950 was lower in childhood but exceeded the male rate between the 20th and 40th years only to fall from the 44th to the 60th year and then rise to a peak of 19.3 after the 70th year. The chief reservoir of tuberculous infection is now in males over 40 and females over 60 years of age. This is the seed bed from which the children of this and the next generation will be infected unless all of the active cases in this age group are detected, isolated in sanatoriums and treated.

It need not be emphasized here that almost as many new cases are being found now as were being found when the death rate was four times as high. Indeed, one may conclude that the present rapidly declining death rate is an artificial condition brought about by (1) early diagnosis, (2) better medical treatment, (3) better surgical treatment and is not the result of a natural decrease in either the prevalence or severity of the disease tuberculosis. If the efficiency of medical and surgical treatment should continue to improve we might find ourselves in an anomalous situation in which there were no deaths but with a continuing heavy and expensive load of active cases in our hospitals and sanatoriums.

The greatest defect in our present methods of control is the lack of specific information in regard to the number, age and sex distribution of individuals who have been infected, as shown by a positive tuberculin test.

The Tuberculin Test

The importance of the tuberculin test in the program for the elimination of tuberculosis cannot be over estimated. The percentage of positive tuberculin reactors is an indirect measure of the amount of undetected open tuberculosis in the community. The presence of a positive tuberculin test pinpoints the individuals which comprise the group in which new active cases will develop. The discovery of a recent conversion from a negative to a positive tuberculin reaction means that there is a known or unknown active case among the converter's associates.

The low percentage of positive tuberculin reactors in the school children of Wisconsin, Minnesota and other midwestern states gives a false sense of security about the total number of reactors in the entire population. Three counties in Minnesota, with a tuberculin reaction rate in its school children of about 5 per cent, conducted a county wide tuberculin survey and found a positive reaction rate of over 50 per cent in individuals over 50 years of age.

There is a rough correlation between the percentage of the population with positive tuberculin reactions and the number of clinical cases and the number of deaths from tuberculosis. When there was almost universal

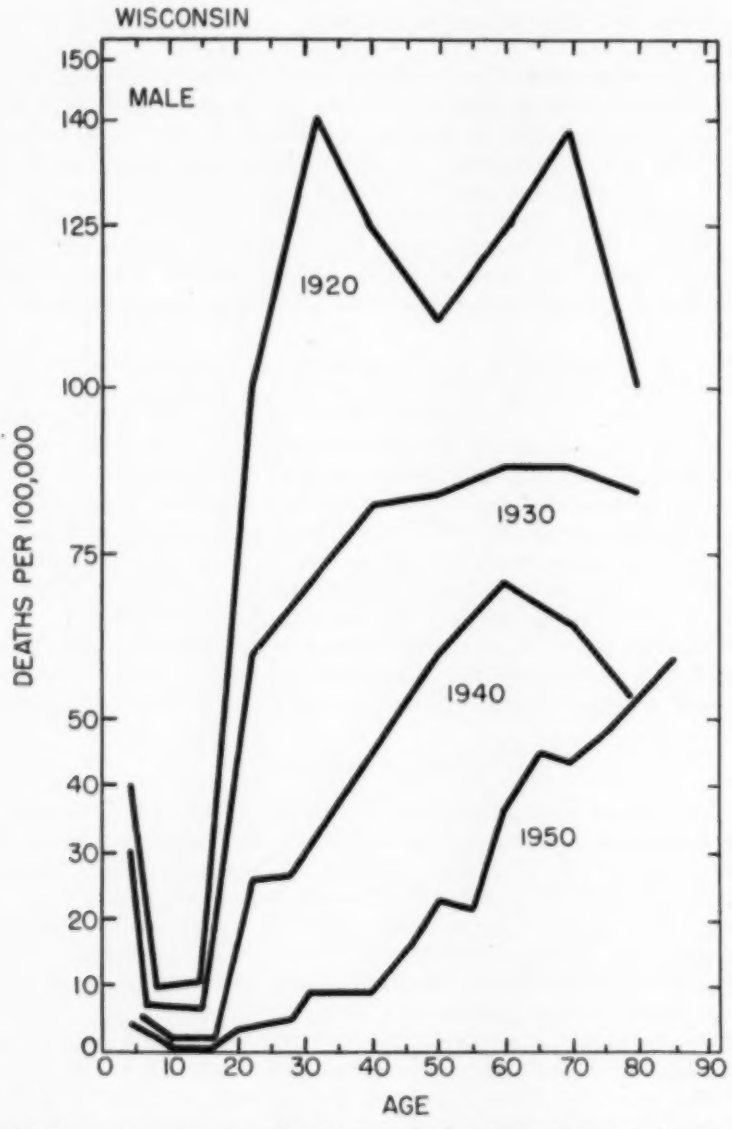

FIGURE 2: These curves show the death rate of males in Wisconsin for the years 1920, 1930, 1940 and 1950. Note the decrease of the death rate in infancy and the sharp rise in 1950 of deaths after the age of 40. The data for the 1950 curve was supplied by Duane L. Sternitzky. The other curves are from Carroll E. Palmer, U. S. Public Health Service, 1943. Volume 1.

saturation of the population with tubercle bacilli as shown by almost 100 per cent positive tuberculin reactions by the age of 20; it was found that the peak in the deaths was in infancy and in young adults (Figure 1).

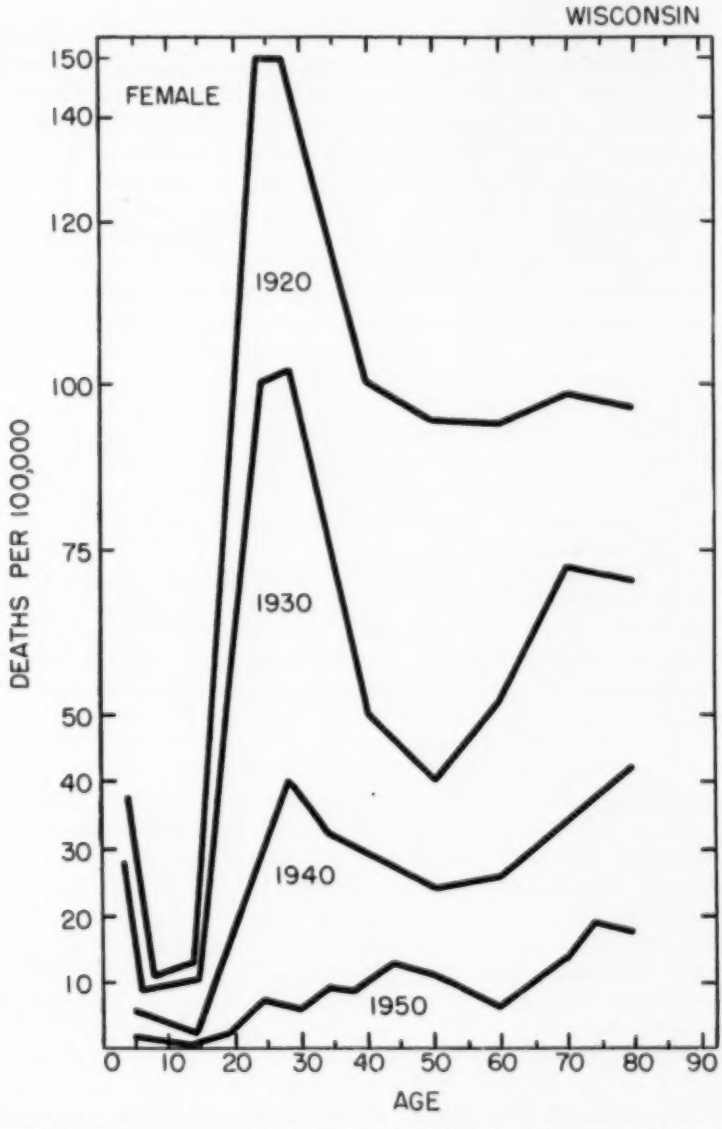

FIGURE 3: These curves show the death rate of females in Wisconsin for the years 1920, 1930, 1940 and 1950. Note the decrease in rate in infancy and the rise after 60 in the 1950 curve. The data for the 1950 curve was supplied by Duane L. Sternitzky. The other curves are from Carroll E. Palmer, U. S. Public Health Service, 1943. Volume 1.

As tuberculosis was detected and isolated in sanatoriums for treatment there was a rapid decrease in infant mortality and an abolition of the peak of deaths in young adults. This change was accompanied by a reduction in positive tuberculin reactors in school children from nearly 50 per cent to about 5 per cent.

In 1950 in Wisconsin there were only 59 deaths in the population between the ages of 0 and 19 years but 657 in the population between the ages of 50 and 80. This gives an average rate of 1.7 deaths per 100,000 for the ages of 0 to 19 and 26 per 100,000 for the ages of 50 to 80. The school children in Wisconsin had only 5 per cent positive tuberculin reactors and we assume, from the Minnesota data that the older groups had a tuberculin rate of 50 per cent. This gives a ratio of 0.34 deaths per 100,000 for each 1 per cent of tuberculin reactors in the school age group and 0.52 deaths per 100,000 for 1 per cent reactors in the elderly group.

The corresponding data from Minnesota for the year 1952 shows seven deaths or a death rate of 0.678 per 100,000 in the age group of one to 19 years. In contrast there were 142 deaths in the age group of 50 years and older with a rate of 19.38 per 100,000. The tuberculin rate in school children in Minnesota is now about 3 per cent in contrast to 50 per cent for adults over 50. When calculated for 1 per cent of tuberculin reactors in each group this gives a ratio of 0.22 among the school children and 0.4 among the adults over the age of 50. The new case rate for the age group of one to 19 years was 15.7 per 100,000 and for the age group of 50 years and over 142.52 per 100,000.

The data collected from the states of Wisconsin and Minnesota needs larger samples of tuberculin tests especially among adults of different ages; but when the data is available it may be possible to predict from the percentage of positive tuberculin reactors in the population, the expected annual number of new cases and the annual number of deaths from tuberculosis.

The X-ray

As the program for the elimination of tuberculosis progressed intensive x-raying of certain segments of the population will probably replace general mass x-ray surveys. It is no longer practical or economical to x-ray the entire school population to find new cases of active tuberculosis. But, as we have seen above, repeated annual x-rays on males above 40 and females above 60 would yield many active cases of tuberculosis as well as cases of carcinoma of the lung and cases of heart disease. Under ideal conditions each individual with a positive tuberculin reaction should be x-rayed every year.

The routine x-raying of every hospital admission has yielded from two to 10 times as many active cases of tuberculosis as mass x-ray surveys in the same areas. Before long it will cease being an economical method of finding tuberculosis in patients under 40 years of age. A more practical procedure would be admission tuberculin tests on all patients followed by an x-ray of all positive reactors below 40 years of age and an x-ray of all

individuals over 40 whether tuberculin positive or tuberculin negative. The same method of tuberculin testing and x-raying could be carried out in the offices of private practioners of medicine.

The Elimination of Tuberculosis

The tools are available, if we have the enthusiasm and patients to apply them, to accomplish the elimination of tuberculosis. The key to elimination is the tuberculin test. Without the tubercle bacillus in the human body there can be no tuberculous disease. The positive tuberculin test tells us which individuals have living virulent tubercle bacilli in their bodies and are, therefore, potential active cases of the disease. An annual x-ray, or more often if symptoms appear, should detect the disease early enough to cure the patient before he or she has infected others. Routine annual x-rays, without preliminary tuberculin tests, should be continued for the heavily infected group of individuals who are now 40 years of age or over until this group has lived out its allotted span of time.

Time Required for Elimination

Some of you may have been shocked by the suggestion in the title of this address that 50 years would be required to eliminate tuberculosis from the midwestern states. I assure you that this is a conservative estimate based upon a series of assumptions such as: (1) no disturbance in our present high standard of living, (2) no catastrophic war or social upheaval, (3) an increase rather than a diminution in case finding programs and (4) a maintenance of the present sanatorium system with its expensive medical and surgical treatment.

The long incubation period for the development of clinical tuberculosis is the explanation for the long time required for the elimination of the disease. By incubation period we mean that period of time from the entrance of the tubercle bacilli into the human body and the subsequent development of a positive tuberculin test, and the first appearance of clinical symptoms or x-ray evidence of pulmonary tuberculosis. To this must be added the prolonged persistence of tubercle bacilli in the bodies of those who have been treated and are apparently well. All physicians can recall instances where a young man in his twenties has been "cured" by sanatorium treatment and has remained well for many active years only to relapse with a positive sputum in his seventies and die of the disease. Even more disturbing is the child who is infected and acquires a positive tuberculin test at the age of 8 and does not develop clinical tuberculosis until the age of 80.

There is only one other human disease which has a comparable long incubation period and a comparable long period of infectivity. That disease is leprosy. Leprosy was eliminated from Europe between 1300 and 1600 A.D. by an intensive program of isolation. All patients with leprosy and even those suspected of leprosy were isolated in leproasiums for the remainder of their lives. It required 300 years to eliminate leprosy from

Western Europe. Leprosy did not disappear spontaneously and it persists even today in tropical countries where rigid isolation has not been practiced.

SUMMARY

To eliminate tuberculosis the present program of education, case finding, treatment in sanatoriums and rehabilitation must be continued and intensified. This program should be supplemented by mass tuberculin testing to locate the individuals who are well but who have in their bodies living tubercle bacilli which may later produce active disease. Males over the age of 40, females over 60 and all individuals with positive tuberculin tests should have an annual x-ray film of the chest.

RESUMEN

A fin de eliminar la tuberculosis el programa actual de educación, búsquede de casos, tratamiento sanatorial y rehabilitación, debe continuarse e intensificarse.

Este programa debe ser completado por investgación de la-reacción tuberculínica en grandes grupos a fin de descubrir a los individuos que se encuntran bien, pero alojan en su organismo bacilos vivos que más tarde pueden producir la enfermedad activa. Los hombres con más de 40 años de edad y las mujeres sobrepasando los 60, así como todos los individuos con reacción tuberculínica positiva, debenhacerse una radiografía de tórax cada año.

RESUME

L'auteur présente un programme qui permettrait d'éliminer la tuberculose. Il demande que soient continués et intensifiés la propagande éducative, le dépistage et le traitement dans les sanatoriums, et la réadaptation. A ce programme devrait être ajoutée la recherche systématique des réactions tuberculiniques pour identifier les individus qui sont en bon état de santé mais qui renferment dans leur organisme des bacilles tuberculeux vivants, capables d'être à l'origine d'une affection évolutive ultérieure. Les hommes de plus d 50 ans et les femmes de plus de 60 ans ainsi que tous les individus dont les réactions tuberculiniques sont positives devraient avoir une radiographie annuelle du thorax.

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An Analysis of 2811 Chest Casualties of the Korean Conflict

A. R. VALLE, LT. COL., MC, USA, F.C.C.P.
Washington, D. C.

In this paper we present an analysis of the 2811 chest casualties of the Korean Conflict which were treated at Tokyo Army Hospital between the beginning of the war and March 1953. A previous report covering 1535 of these casualties has been published.[21] However, this paper adds more than 1000 cases and contains data which was not available at the time of the previous report. Some conclusions are repeated because additional experiences only served to bear out their validity.

Tokyo Army Hospital was the center for treatment of thoracic casualties. Approximately 85 per cent of our patients were United States military personnel and 15 per cent were members of forces contributed to the Korean effort by other United Nations.

During the first few months of the conflict, definitive treatment could not be administered overseas because casualties could be hospitalized in the theater only 30 days. However, as the bed capacity increased, the period of hospitalization was increased to 120 days, making definitive treatment possible.

In this series we have included only those patients who suffered injuries to the intrathoracic viscera and do not include those with only superficial wounds of the chest. Of these wounds, 1968 (70 per cent), were of the penetrating type, 787 (28 per cent), of the perforating type and 56 (2 per cent), were results of crushing injuries.

Hemothorax

The most frequent complication of intrathoracic wounds is hemothorax with or without associated pneumothorax. This intrapleural blood may remain fluid or may coagulate and begin to organize. In this series 1744 patients (52 per cent) had hemothoraces either on admission or developed them within the first two weeks after admission. Of this number 1291 (74 per cent) remained sterile and 453 (26 per cent) became infected.

We treated hemothorax by simple thoracentesis without air replacement. Following removal of the fluid, 300,000 units of crystalline penicillin and 1 Gm. of streptomycin were instilled. The procedure was repeated every 24 hours, or more often if indicated, until no fluid could be obtained and the chest appeared normal to physical and x-ray examination. Specimens of the fluid removed were sent to the laboratory for culture, antibiotic sensitivity tests, and other studies as indicated. If infection was present, the antibiotic of choice was administered systemically and intrapleurally, depending upon the manner in which the drug could be administered.

*Presently: Surgical Service, U. S. Public Health Service Hospital, Detroit, Michigan.

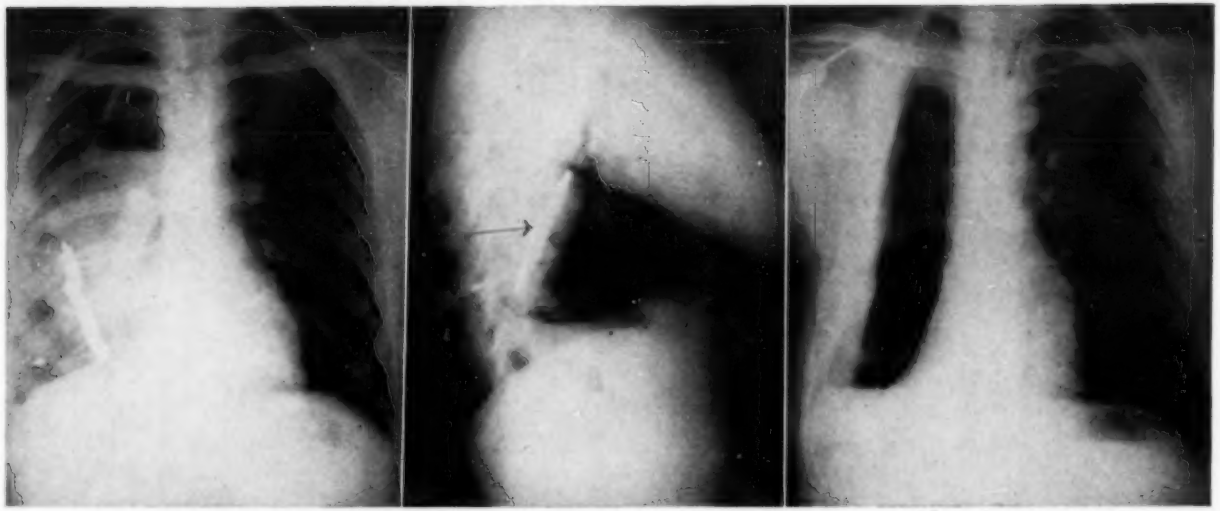

FIGURE 1 FIGURE 2 FIGURE 3

Figure 1, (Case 1): This patient received a penetrating wound of the right posterior chest. This picture shows a large shell fragment in the right lower chest. There is also a large cavity containing fluid and air.—*Figure 2,* (Case 1): Lateral view of the same patient showing the shell fragment posteriorly.—*Figure 3* (Case 1): Same patient after a right total pneumonectomy and partial thoracoplasty. Patient is doing well one year after surgery.

Penicillin, streptomycin, terramycin, aureomycin, and chloramphenicol were utilized.

Eighty per cent, or 1395 patients, completely recovered after being treated by thoracenteses and antibiotics only. Sixty-eight per cent were returned to duty and the remainder were evacuated to the zone of interior because of other wounds although they were recovered as far as their chests were concerned.

Many patients had clotted hemothoraces on admission to the hospital or within two days after being wounded. From a review of their records, it would seem that the hemothorax clotted within a few hours after wounding, because at no time was any fluid obtained by aspiration. In others the hemothorax coagulated gradually, taking from three or four days to two weeks.

Decortication is the established method of treatment for those patients with significant clotted or organized hemothoraces.[3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 15, 16, 19] A total of 254 decortications were performed on patients with both infected and non-infected organized hemothoraces. Of these, 76 per cent were infected and 24 per cent were noninfected. Ninety-one per cent were considered as having excellent results, 4 per cent having fair results, and 5 per cent as poor results.

It is noteworthy that 92 per cent of the patients who needed decortication had closed intercostal drainage tubes inserted in Korea.[23] We feel that closed intercostal drainage has many disadvantages as an early treatment for hemothorax. It increases the hazards of evacuation, since the tubes are often found improperly clamped off and fluid from the bottles is sucked back into the chest. Furthermore, in hemothorax, closed drainage usually loses its value within 24 to 36 hours because of occlusion of the tube by fibrin and clots and by pleural adhesions about the intrathoracic portion of the tube.[21, 22, 23]

After performing decortications at intervals of one to eight weeks following injury, it was decided that the optimum time for such operation is within three to five weeks after injury. From a review of the reports published by surgeons who had experience in treating chest casualties during World War II, it would seem that there is general agreement upon this interval.[10, 11, 12] In those operations performed early, the bleeding is much more severe, there is more edema, and foreign bodies, if present, are more difficult to locate.

In 18 cases we used streptokinase and streptodornase according to the procedure described by Tillett and Sherry.[14, 17, 18] We obtained such poor results that their use was discontinued.

Foreign Bodies

It was the policy at Tokyo Army Hospital to remove only those foreign bodies which exceeded 1.5 cm. in their greatest diameter, unless, of course, they were in such a location as to be regarded as dangerous to the patient, cause some pathologic changes within the chest, or produced symptoms. Persistence or development of reaction about the missile indicated the

need for exploration and removal.[1, 2]

Three hundred and twenty-seven patients had retained foreign bodies which necessitated removal. Approximatly 85 per cent of these were shell fragments which varied in size from 1 cm. to 9 cm. in diameter and the remaining 15 per cent were bullets of various calibre. When the foreign body was a shell fragment the incidence of infection was high, running from 60 to 70 per cent. When the foreign body was a bullet, the incidence of infection was about 10 per cent.

Among the 327 patients operated on at Tokyo Army Hospital solely for the removal of foreign bodies, the postoperative empyema incidence was only 2 per cent. The majority of these patients returned to duty, but a small number had to be returned to the zone of interior because of other wounds.

We found that delaying the operation for removal of foreign bodies for two to three weeks, if possible, decreased the amount of bleeding at operation and made location of the foreign body easier. Also the patient was usually in much better condition to tolerate the thoracotomy procedure. In reviewing the records, we also found that the empyema incidence among some 150 patients who were operated upon in forward areas for removal of foreign bodies was 25 per cent.

Mediastinal Injuries

One hundred seventeen or slightly more than 4 per cent of our patients suffered mediastinal wounds. The majority of them also had retained

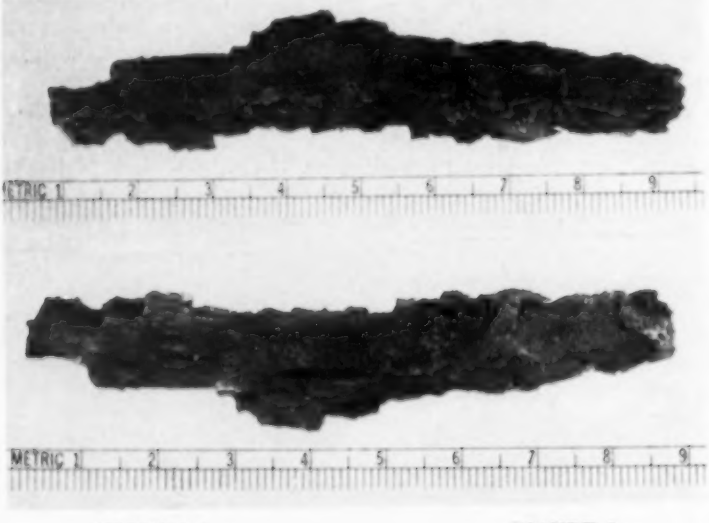

FIGURE 4 FIGURE 5

Figure 4, (Case 1): This picture shows the shell fragment of the same case. A piece of clothing can be seen in the right end of the fragment.—*Figure 5*, (Case 1): This picture shows the other side of the shell fragment with the clothing on the right side.

metallic foreign bodies. Approximately 65 per cent developed infections which were drained through the pleural space.

We removed 32 foreign bodies from the mediastinum, 10 from the pericardium, and 16 from the myocardium. Three had foreign bodies in the intraventricular septum which we did not remove.

Forty-two developed pericardial effusions which were treated with pericardiocenteses and antibiotics. Pyogenic organisms were obtained from culture of the aspirated fluid in about 40 per cent of the cases.

The following table shows the extent to which other structures in the mediastinum were injured:

Esophagus	9
Aorta	8
Thoracic Duct	5
Vena Cava	3
Trachea	5

The majority of these patients, with the exception of those with injuries to the heart and great vessels, were returned to duty in the theater.

Thoraco-Abdominal Wounds

It was our experience that many cases with thoraco-abdominal wounds involving the upper abdomen could be handled adequately through the thoracotomy. The exposure is good and it obviates the necessity of an abdominal or thoraco-abdominal incision. We found that patients who needed extensive abdominal surgery made better progress when separate thoracotomies and laparotomies were done than when a thoraco-abdominal incision was made. Also, infection, if it developed, was more localized when separate incisions were made.

Generally patients who suffered injuries to the diaphragm and spleen in conjunction with their chest wound had these injuries repaired at the time of the thoracotomy. We repaired 186 injuries to the diaphragm and performed eight splenectomies. The majority of these patients were returned to duty in the theater.

Patients with serious liver damage, multiple intestinal perforations, with or without resection, colostomies, nephrectomies, etc. were evacuated to the zone of interior for definitive chest surgery. If necessary the temporizing procedure of open drainage with rib resection was carried out so that they could be safely evacuated.

The table below gives the extent to which various abdominal organs were injured.

Liver	201
Spleen	82
Large intestine with colostomy	52
Small intestine	18
Stomach	48
Kidney	43

Approximately 15 per cent of our patients suffered wounds involving both the chest and abdomen. Four deaths, or slightly less than 25 per cent of our mortality, were in this group.

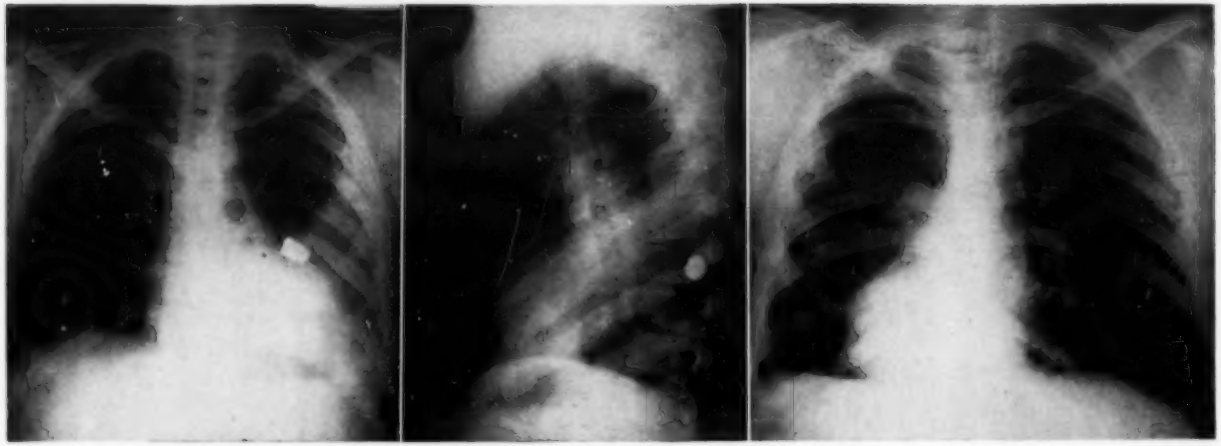

FIGURE 6 FIGURE 7 FIGURE 8

Figure 6, (Case 2): This patient received a penetrating wound of the left lateral chest. This picture shows a left organized hemothorax with a 45 caliber bullet in the left lower chest.—*Figure 7*, (Case 2): Same patient showing an organized hemothorax and a 45 caliber bullet in the left lower posterior chest.—*Figure 8*, (Case 2): Same patient after left decortication and removal of bullet. Patient went back to duty and is doing well two years after surgery.

Other Injuries

A large number of our patients suffered nerve injuries and/or orthopedic injuries along with their chest wounds. Those whose injuries were so serious that there was little likelihood of their returning to duty in the theater usually received only palliative treatment, such as thoracentesis or thoracotomy drainage with rib resection, and were then evacuated to the zone of interior.

Bacteriology

Many kinds of bacteria were isolated on culture of the fluid aspirated from the chests of our patients. In the beginning, the infection was usually a mixed one, made up of various gram-negative rods and gram-positive cocci. However, as antibiotic treatment continued the gram-negative bacilli, such as E. coli, E. freundii, Aerobacter aerogenes, pseudomonas aeroginosa, various proteus species, etc., were usually destroyed, leaving only the gram-positive cocci to be dealt with.

Hemolytic and non-hemolytic streptococci were isolated in a number of cases, but by far the most common and most persistent organism encountered was hemolytic, salt-resistant, mannitefermenting (coagulase positive) staphylococcus. The streptococci were easily controlled by antibiotics, but usually the staphylococcus became resistant to all antibiotics except chloramphenicol in very high concentrations.

We found various types of proteolytic clostridia in a number of cases which could account for the massive destruction of lung tissue found.

Morbidity

The prime factor in the treatment of chest casualities is the restoration of normal cardio-respiratory physiology as soon as practicable.[3, 20] All such procedures as thoracentesis, decortication, removal of foreign bodies and irreparably damaged lung tissue, repair of the diaphragm and the chest wall help restore normal function and decrease morbidity.

We feel that physiotherapy is an important adjunct in decreasing morbidity.[6] If possible, it is started on the third postoperative day. The patients begin with breathing exercises and blow into bottles and engage in passive and active exercise of the shoulder and arm of the operated side simultaneously.

The period of hospitalization, in most instances, varied from three to six weeks. Following discharge from Tokyo Army Hospital, patients who were considered candidates to return to duty in the theater were sent to Camp King. This camp was a convalescent and reconditioning center. It was operated under medical supervision and the amount of activity was gradually increased to combat peak. Patients who could not stand the rigors of combat conditions were weeded out and sent to limited duty.

Approximately 80 per cent of the chest casualties who had definitive treatment at Tokyo Army Hospital returned to duty in the theater. A considerable number who had to be evacuated eventually returned to duty, but we have no data concerning them.

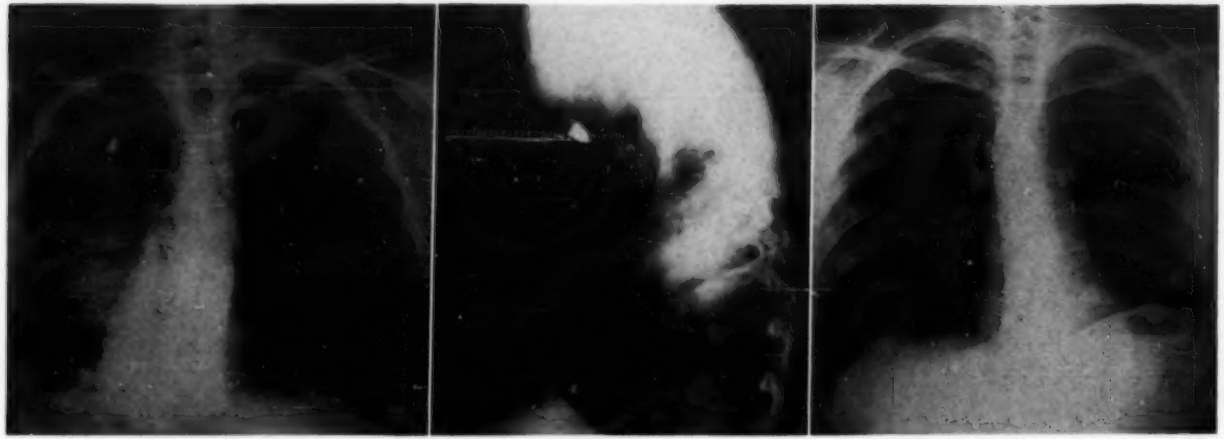

FIGURE 9 FIGURE 10 FIGURE 11

Figure 9, (Case 3): This patient received a penetrating wound of the left posterior chest. This picture shows a small shell fragment in the left upper chest and a round encapsulated hematoma of the left lower lobe.—*Figure 10,* Case 3): Lateral view of the same patient showing the shell fragment in the left upper chest and the round hematoma of the dorsal segment of the left lower lobe.—*Figure 11,* (Case 3): This picture shows the same patient after removal of foreign body and segmental lobectomy.

Mortality

It is assumed that the initial mortality in thoracic wounds must be high, but we have no overall figures regarding the mortality of chest wounds in the Korean conflict. However, the delayed mortality appears to be lower than might be expected. Our overall mortality at Toyko Army Hospital was 0.6 per cent and that reported for the Yokasuka Naval Hospital was 1.9 per cent.[7]

We had 17 deaths in 2811 cases. Eight of them died as a result of serious wounding: four died of thoraco-abdominal wounds, one of pulmonary embolism, one of cardiac tamponade, and two from serious nerve injuries. Nine of our deaths were due to homologous serum hepatitis. Many others, all of whom had received numerous transfusions of plasma and whole blood, developed jaundice but did not succumb.

More than 800 major operations, excluding thoracotomy drainages, were performed without a death.

Decortications	254
Lobectomies and partial resections	169
Pneumonectomies	5
Splenectomies	8
Thoracotomies for removal of foreign bodies, etc.	435

Many factors contributed to this low mortality. We had the benefit of the experience of the chest surgeons in the rather recent World War II; we had more and improved antibiotics; there was plasma and whole blood readily available for transfusion near the battle lines; the Mobile Army Surgical Hospitals could do major surgery if necessary just a few miles from the front lines; evacuation was very rapid. Lastly, but of great importance, the patients were healthy young men with an average age of 23 years.

Late in the war protective vests were introduced which helped decrease the mortality of chest wounds. They were most effective in stopping low velocity missiles and many soldiers who would have been instantly killed if not protected by the vest, were only wounded.

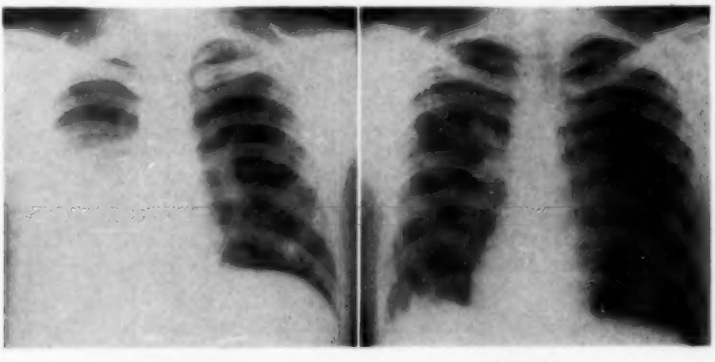

FIGURE 12 FIGURE 13

Figure 12, (Case 4): This patient received a perforating wound of the left chest. This picture shows a left organized non-infected hemothorax.—*Figure 13,* (Case 4): Same patient after left decortication.

CONCLUSIONS

Our experience with 2811 chest casualities indicates that, in general, the best early treatment for chest wounds is the most conservative one.

Thoracentesis is the most effective treatment for hemothorax. Approximately 80 per cent of the patients with hemothorax were cured by thoracentesis and antibiotic treatment. We feel that closed intercostal drainage is seldom necessary and often dangerous. Ninety-two per cent of those patients who required decortication had intercostal drainage tubes inserted in Korea.

Decortication is the accepted treatment for clotted or organized hemothorax and the best results were obtained by performing this operation within from three to five weeks following injury. The optimum time for removal of foreign bodies is within two to three weeks after injury.

We found breathing exercises and physical therapy helpful in reducing morbidity.

We estimate that approximately 90 per cent of the casualties who suffered chest wounds only were returned to duty.

CONCLUSIONES

Nuestra experiencia con 2811 lesiones de tórax, indica que en general, el mejor tratamiento inmediato para las heridas de tórax, es el conservador.

La toracentesis es el medio más efectivo para el hemotórax.

Aproximadamente el 80 por ciento de los enfermos con hemotórax, se curaron con toracentesis y antibióticos. Creemos que el drenaje intercostal cerrado rara vez, es necesario y a menudo es peligroso. Noventa y dos por ciento de los enfermos que requirieron decorticación, tenían tubos que se les habían insertado en Corea.

La decorticación es el tratamiento aceptado para el hemotórax coagulado u organizado y los mejores resultados se obtienen realizando la operación dentro de tres a cinco semanas después de la herida. El tiempo óptimo para extraer cuerpos extraños, es de dos a tres semanas después de la herida.

Encontramos que los ejercicios respiratorios y la fisioterapia, es útil para reducir la morbilidad.

Estimamos que aproximadamente el 90 por ciento, de los que sufrieron heridas de tórax solamente, volvieron al servicio.

RESUME

L'auteur développe l'expérience qu'il a acquise par l'étude de 2.811 accidents ayant touché le thorax. En général; le meilleur traitement d'urgence pour les blessures thoraciques est celui qui se montre le plus conservateur.

Pour l'hémothorax; c'est la thoracenthèse qui est la thérapeutique la plus efficace. Environ 80% des malades atteints d'hémothorax furent guéris à l'aide de la thoracenthèse associée aux antibiotiques. L'auteur estime que le drainage intercostal à plèvre fermée est rarement nécessaire, et se montre souvent dangereux. 92% des malades pour lesquels une

décortication pleurale était nécessaire, avient été l'objet d'un drainage inter-costal pratiqué en Corée.

Le traitement qui s'impose pour les hémothorax coagulés et organisés est la décortication. C'est en réalisant cette opération dans le cours de trois à cinq semaines, suivant la blessure, que l'on obtint les meilleurs résultats. Le meilleur moment pour procéder à l'ablation d'un corps étranger se situe entre deux à trois semaines après la blessure. L'auteur a constaté que les exercices respiratoires et la physiothérapie furent d'un grand secours pour éviter les suites pathologiques.

Il estime qu'environ 90% des cas de blessures exclusivement localisées au thorax ont permis la reprise de l'activité.

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Tuberculous Pericarditis: The Effect of Streptomycin*

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Before the discovery of effective chemotherapy, tuberculous pericarditis had a very bad prognosis and a very high mortality. Harvey and Whitehill[1] reported an 83% mortality of 37 proven cases, most of the patients dying within months of the onset of symptoms. Carroll[2] reported 71 cases, of which 39 (54.9%) died within two years of the onset of the disease.

The use of streptomycin has greatly altered the prognosis of other forms of tuberculosis. Since pericarditis is usually secondary to recognized tuberculosis of some other part of the body and only rarely is primary, it might be hoped that proper treatment of pre-existing tuberculosis of the lungs, bronchi, and lymph nodes would reduce the incidence of tuberculous pericarditis. As a large number of deaths have, in older reports, been caused by co-existing tuberculosis elsewhere, it might be expected that streptomycin treatment would reduce the mortality rate by controlling the systemic infection. Finally it might be anticipated that early use of streptomycin would shorten the duration of the illness and prevent or minimize the formation of adhesive pericarditis.

Since pericarditis is an unusual condition, review of the available literature gave little information on streptomycin-treated patients. For this reason the diagnosed cases of tuberculous pericarditis at Sunny Acres Hospital and the Cleveland City Hospital were reviewed and re-examined. The number of patients so diagnosed was too small to allow valid comparison with the incidence before the use of streptomycin.

Thirteen patients with tuberculous pericarditis were treated. All were males, ranging from 14 years to 62 years in age. The average age was 37.7 years. Six were white and seven were Negroes. The presence of fluid within the pericardium was demonstrated by pericardiocentesis in ten of the thirteen cases, and by definite changes in serial chest films and by fluoroscopy in the remaining three. Acid-fast bacilli were obtained from the pericardial fluid in only two of the cases. The tuberculous origin was assumed in the remainder from the presence of tuberculosis elsewhere. Acid-fast bacilli were obtained from the sputum of eight patients. Lymph node biopsy confirmed the diagnosis of tuberculous infection in two cases. Smear from a bronchial sinus tract contained acid-fast bacilli in one. Two patients are included without bacteriologic evidence of tuberculous infection. One severely ill man had chest film and clinical course consistent with miliary tuberculosis and tuberculous meningitis. The other, a coal miner, had the appearance of tuberculosilicosis. Both showed a good initial response to streptomycin.

Pulmonary tuberculosis was present in nine cases, minimal in two, mod-

*From Sunny Acres, Cuyahoga County Tuberculosis Sanatorium, Cleveland, Ohio.

erately advanced in three, and far advanced in one. Tuberculosilicosis with stage of tuberculosis unknown was diagnosed in two additional patients, and miliary tuberculosis in one. Pleural effusions were present in five. Tuberculous cervical lymphadenitis was proved by biopsy in two, and noted during physical examination of a third. Mediastinal or hilar lymphadenopathy was noted in the chest films of three, and was suggested in another by the presence of a bronchial sinus. One patient had tuberculous epidydimitis.

The response to streptomycin was striking in most cases. There was usually some reduction in the degree of fever within a few days to a week after beginning treatment. The duration of fever after initiation of streptomycin varied from 8 days to 120 days, the average being 63½ days, or nine weeks. This is somewhat shorter than the thirteen weeks average reported by Myers and Hamburger[3] for three cases of primary tuberculous pericarditis treated with streptomycin, and much shorter than the twenty-one weeks they note for four patients treated without streptomycin.

At the conclusion of the study, living patients had been followed from thirteen months to almost six years after the onset of pericarditis. One patient who had been transferred to a mental hospital could not be seen, although he is still living. Four patients are dead and nine are living.

Eight of the nine living patients were re-examined. A 55 year old colored male is still in the hospital under restricted activity, thirteen months after the onset of pericarditis. Despite salt free diet he has liver enlargement, the edge being palpable 4 centimeters below the costal border. Fluoroscopically the cardiac motion is moderately reduced, suggesting some significant degree of constrictive pericarditis.

A 40 year old white male has been observed for twenty-one months since the onset of symptoms of pericarditis. He has continued to receive streptomycin and para-amino salicylic acid during the entire observation period although he has been out of the hospital for nine months. He has had recurrent pleural effusion which requires frequent aspiration, and also is in mild congestive failure despite digitalis, mercurial diuretics and salt free diet.

The remaining six patients show no evidence of cardiac abnormality, two to six years later. Fluoroscopically cardiac motion is apparently normal, electrocardiogram shows no significant deviation, venous pressure and circulation time are within normal limits, and chest films show no evidence of pericardial calcification. Some of these patients have been moderately restricted in their activity as advised for concomitant pulmonary tuberculosis.

The first case in this series began treatment almost six years ago. During subsequent years the schedule of treatment has been altered radically. Only eight of the patients received para-amino salicylic acid with streptomycin. One received streptomycin for only one month, and three for only two months. The more recently treated patients have received longer courses of treatment with at least two years continuous treatment contem-

plated. One patient received isoniazid after 18 months treatment with streptomycin, without apparent benefit.

Deaths occurred in the only case of miliary tuberculosis in the series, the only far advanced pulmonary tuberculosis and in one of the two silicotics. The two with minimal and three with moderately advanced pulmonary tuberculosis are living four to five years and nine months after the onset. All patients in whom lymph node disease was diagnosed are living. One of the two patients with positive culture of the pericardial fluid is still living after 21 months, the other died after 23 months.

The cause of death was constrictive pericarditis and cardiac failure in two, although in one of these extensive tuberculosilicosis was an important factor. One patient died of tuberculous meningitis and one during an unsuccessful attempt at pericardiocentesis. Unfortunately autopsy was performed in none. The time of death varied from 17 days to 23 months after the onset of symptoms.

Of the living patients, two have definite signs of constrictive pericarditis, with mild signs of congestive failure. Thus, theoretically, pericardiectomy might have been of value in four patients. It was considered indicated in one, contraindicated in one by the presence of extensive pulmonary disease and poor pulmonary function. It is yet to be considered in two. The eight remaining patients are apparently recovered, with no recognized constriction or disability.

A review of the natural course of the disease is a necessary preliminary for the evaluation of treatment. Pericardial effusion is a usual feature in early pericarditis. The effusion may be serous, sero-sanguineous, hemorrhagic, or purulent, bloody fluid being most common. In this series the fluid was sero-sanguineous in six of the eight cases where the character is described. The fluid may collect rapidly, small collections then embarrassing the heart, or may develop slowly, stretching the pericardium until large amounts are present. Some degree of cardiac tamponade results with consequent cardiac failure. Death may occur in this stage of the disease as a result of mechanical interference with cardiac action.

Extrapericardial tuberculosis may also cause death at any stage of the disease. Carroll[2] analyzed 71 untreated cases of whom 39 patients died within two years of the onset. Of these, 33 had widespread tuberculosis. Cardiac failure was present terminally in 20 and was severe in only 9. He felt that 40.5% died of widespread tuberculosis and only 8.5% died of cardiac failure. He thus concludes that widespread tuberculosis is the main cause of death and that cardiac tamponade is fatal less often.

The analogy between tuberculous pericarditis and tuberculous pleuritis is obvious. As the aspiration of pleural effusion is considered contraindicated in the acute toxic stage of the disease in the absence of symptoms from the volume of fluid, so pericardiocentesis is considered contraindicated by some clinicians during the febrile period unless signs of cardiac tamponade are present. In such a situation x-ray evidence of an increase in the size of the cardiac silhouette and a typical globular shape together with fluoroscopic observation of markedly decreased cardiac pulsation and a

change of the cardiac outline with change from the erect to supine and Trendelenburg position are considered necessary for the diagnosis of pericardial fluid.

Falk and Ebert[4] report seventeen patients with pericardial effusion with circulatory failure in whom streptomycin was employed as the primary treatment. Eight of these were improved after treatment, eight unchanged, and one worse. After up to two years observation ten were living and seven were dead. Three patients had undergone pericardiectomy, of whom one died and two lived. The causes of death in their series were tuberculous meningitis in two, air embolus in two, miliary tuberculosis in one, and circulatory failure in one. One additional patient died four days after pericardiectomy. Of the ten living patients they list the circulatory status as normal in seven, improved in two, and worse in one.

Shapiro and Weiss[5] report fourteen cases treated with streptomycin with an observation period of forty months in the oldest case. Six of their patients died, four of whom had miliary tuberculosis. Half of these died within three months of the onset of the disease.

Comparison of these studies reveals a mortality rate of 41.2% in the series of Falk and Ebert, 42.8% in Shapiro and Weiss's group and 30.8% in this study. The total of these three reports is 44 cases with 17 deaths, a mortality rate of 38.6%. These statistics may be compared with those reported by Andrews and others[6] who studied 18 patients with tuberculous pericarditis with failure. At the time of their study ten patients were dead and eight living. Six of the latter had been subjected to pericardiectomy. Comparison with the report of Carroll[2] of 40.5% dying of widespread tuberculosis and 8.5% of cardiac failure suggests that the major difference in mortality in the present series has been in the control of systemic tuberculosis. The high incidence of miliary tuberculosis reported by Shapiro and Weiss[5] remains impressive, however.

The difference in mortality rate for tuberculous pericarditis with effusion between those with positive bacteriologic proof and those without such evidence makes it exceedingly difficult to compare the various studies, and a variation in the severity of the disease between two small groups might account for most of the difference in mortality and residual morbidity. The cases reported from Johns Hopkins Hospital by Harvey and Whitehill show this difficulty in evaluation. Of 20 patients with proved tuberculous origin 80% died. However of 34 cases so diagnosed clinically but without bacteriologic or pathologic confirmation the mortality rate was only 5.9%. Blalock and Levy,[7] Keefer[8], and Fenger and Hansen[9] report similar discrepancy.

With this variation in mind one might cautiously conclude from the results of this present series that the course of tuberculous pericarditis is significantly shortened, the effects of systemic tuberculosis are somewhat decreased, and the residual constrictive pericarditis may be reduced.

It is suggested that constrictive pericarditis develops early, and that an accurate cardiac prognosis may be obtained within two years of the onset.

SUMMARY

Thirteen cases of tuberculous pericarditis with effusion treated with streptomycin are presented. Tubercle bacilli were recovered from the pericardium in only two. The diagnosis in the others is based on strong presumptive evidence. Four died within two years of the onset, while nine are living 13 months to almost six years after the onset of pericarditis. Clinical evidence of constrictive pericarditis developed in two of the patients who died, is present in two of the living patients. When constrictive pericarditis was evident cardiac failure occurred early in the course of the disease, soon after absorption of fluid. Those who were asymptomatic after one year continued to have no cardiac difficulty.

Comparison with other reports in the literature suggests that the prognosis is improved as streptomycin treatment shortens the course of the acute disease, decreases the number of deaths from other forms of tuberculosis, and may lessen the incidence of constrictive pericarditis. It is noted that variation in the severity of the disease makes it difficult to estimate the mortality rate and prognosis, and makes such comparison with the literature somewhat unreliable.

RESUMEN

Se presentan trece casos de pericarditis tuberculosa con derrame tratados con estreptomicina. Se encontró el bacilo de la tuberculosis solo en dos. El diagnóstico en los otros se basó en presunciones muy sólidas.

Cuatro murieron dentro de los dos años del principio en tanto que nueve, aún viven de trece meses a casi seis años después del principio de la pericarditis.

Se presentó evidencia clínica de pericarditis constrictiva en dos de los enfermos que murieron y se encuentra actualmente en dos de los que viven. Cuando la pericarditis era evidente, la insuficiencia cardiaca ocurrió pronto en el curso de la enfermedad, pronto después de la absorción del líquido.

Aquellos que después de un año eran asintomáticos continuaron sintener trastornos cardiacos.

La comparación con otras comunicaciones en la literatura, sugiere que el pronóstico es mejorado porque la estreptomicina acorta la evolución de la enfermedad aguda, disminuye el número de defunciones por otras formas de tuberculosis, y puede disminuir la incidencia de la pericarditis constrictiva.

Se nota que la variación en la severidad de la enfermedad, hace difícil estimar la mortalidad y el pronóstico y hace que tal comparación con lo publicado en relación con esto, poco digno de confianza.

RESUME

L'auteur rapporte 13 cas de péricardite tuberculeuse avec épanchement traités par la streptomycine. Ce n'est que dans deux cas que des bacilles tuberculeux furent décelés dans le péricarde. Le diagnostic dans les autres cas fut basé sur de fortes présomptions. Quatre d'entre eux moururent

dans les deux ans qui suivirent l'atteinte, tandis que neuf autres sont encore en vie, après un délai de 13 mois à 6 ans depuis l'apparition de la péricardite. Chez deux des malades qui décedèrent et chez deux de ceux qui sont encore en vie, on put mettre en évidence ds signes cliniques de péricardite constrictive. Lorsqu'on constata une péricardite constrictive, l'insuffisance cardiaque survint très tôt au cours de l'affection. Les malades qui, au bout d'un an, n'avaient présenté aucune manifestation clinique, n'ont tojours pas eu de troubles cardiaques.

La comparaison avec d'autres observations publiés montre que le pronostic est amélioré depuis que la streptomycino-thé-rapie raccourcit la phase d'atteinte aiguë, diminue le nombre des décès dus à d'autres localisations de la tuberculose, et permet d'abaisser la fréquence de la péricardite constrictive. L'auteur remarque que la variation de la gravité de l'affection rend difficile l'évaluation du taux de mortalité et du pronostic, et dans une certaine mesure rend impossible toute comparaison avec les autres cas déjà publiés.

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Langhans' Giant Cells and Tubercle Bacilli In 91 Pulmonary Tuberculous Lesions Resected After Prolonged Combined Chemotherapy

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Introduction

The Langhans' giant cell described in 1868 is a large cell with numerous nuclei arranged in a ring around the periphery of an eosinophilic cytoplasm.[1, 2] The cytoplasm is homogeneous or granular and may contain inclusions such as *Mycobacterium tuberculosis*. The foreign body type giant cell can be distinguished by the presence of nuclei throughout the substance of the cytoplasm rather than at the periphery. Both cell types are found in the granuloma of tuberculosis as well as the granulomata of sarcoidosis, berylliosis, leprosy, syphilis, actinomycosis, histoplasmosis, coccidiomycosis, leishmaniasis and lymphogranuloma venereum.

Langhans' giant cells are thought to result from the fusion or incomplete, amitotic division of epithelioid cells (histiocytes).[2] In clinical tuberculosis the intact *M. tuberculosis* is thought to be the agent responsible for the formation of giant cells. Lipid extracts (phospholipids) of the tubercle bacillus may cause a giant cell reaction but only with relatively large doses. Numerous other studies have attempted to determine the relative importance of the tubercle bacillus and the host factors in the giant cell reaction. Several recent studies[3-7, 11,12] have indicated that tubercle bacilli in caseous pulmonary tuberculous lesions gradually lose their ability to multiply. This happens with or without the influence of chemotherapy. Careful bacteriologic and histologic studies of 130 consecutive pulmonary tuberculous lesions resected after prolonged combined chemotherapy showed a high correlation between bacterial viability and histologic evidences of "activity," including epithelioid cells, lymphocytes, recent caseation necrosis, giant cells and minimal fibrous reaction.[11] The correlation was particularly high for the 94 lesions without an open cavity.

The present study covers but one facet of the problem. It is an attempt to correlate the relative number of giant cells in small localized tuberculous pulmonary nodules with the results of bacteriologic analysis.

Material and Methods

The material available for this study was obtained during a 28-month interval (January 1951 to April 1953) from patients with bacteriologically proved pulmonary tuberculosis and subjected to various forms of resec-

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tional surgery. Nearly all patients received streptomycin and para-aminosalicylic acid as part of their treatment prior to surgery. Isoniazid was used in only a few. Ninety-one single pulmonary tuberculous nodules removed by "wedge" or "subsegmental" resection were selected for study. In order that the histologic study be thorough, nodules were selected in which the greatest diameter of the diseased tissue did not exceed 2.5 centimeters.* Cavity lesions were not included.

Each piece of resected tuberculous tissue was divided into two equal portions. One was submitted for bacteriologic study for tubercle bacilli. Bacteriologic study included careful scrutiny of a smear of the homogenized lesion; the Ziehl-Nielsen technique was used in staining. The homogenized lesions (both undigested and digested with 3 per cent NaOH) were also cultured on Lowenstein's medium; the cultures were observed for a minimum of two months before being discarded. Finally, digested and undigested emulsions of the resected lesion were inoculated intraperitoneally into separate guinea pigs. The animals were sacrificed after two months and their organs examined grossly and by smear for acid-fast bacilli.

The remaining portion of each lesion was fixed in formalin, embedded in paraffin, sectioned and stained with hematoxylin and eosin. At least two paraffin sections of each lesion were studied for giant cells.

The histologic specimens were carefully scrutinized with special attention paid to the relative number of Langhans' giant cells. The specimen was assigned to Group I only if the paraffin sections of the diseased tissue contained not more than *one* giant cell in the entire paraffin section. The specimen was classified in Group II if microscopic sections revealed the presence of a few to many giant cells.

Group II specimens were heterogenous insofar as the relative number of Langhans' giant cells was concerned. Giant cells were present in small or large numbers. Moreover, the relative giant cell population varied in diffierent portions of the same lesion. Group I lesions were characterized by the uniform and extreme paucity of giant cells.

Results

Table I illustrates the distribution of the 91 lesions according to the giant cell population. The majority (72) of the specimens contained from a few to many giant cells in an average low-power microscopic field (Group II). Twenty per cent were devoid of giant cells in the paraffin sections (Group I). The average duration of chemotherapy prior to surgery was the same in each group.

There was a significantly greater incidence of viable tubercle bacilli in lesions containing giant cells than in the group of lesions devoid of giant cells (Table I). Further analysis of the 72 lesions in Group II revealed that the incidence of bacterial viability did not vary significantly with the relative number of giant cells. Lesions containing viable bacilli

*The present study included nearly all the 94 nodular lesions subjected to a more detailed histologic analysis in a previous paper.[11]

TABLE I
DISTRIBUTION OF LANGHANS' GIANT CELLS IN 91 RESECTED TUBERCULOUS NODULES AND THE BACTERIOLOGY IN EACH GROUP

No. of Langhans Giant Cells	No. of Tbc. Lesions in Each Group	No. of Lesions Containing Viable Tubercle Bacilli		No. of Lesions Containing Acid-fast Bacilli by Smear		No. of Lesions Negative for Acid-fast Bacilli by Smear and Culture		Mean Duration Chemotherapy
		No.	per cent	No.	per cent	No.	per cent	
Group I (0-1 per section)	19	0*	0	9	47	10	52	169 days
Group II (few to many per low-power field)	72	22*	31	47	65	19	26	174 days
Total	91	22	24	56	61	29	32	

*The difference in frequency of viable organisms in Group I and Group II is statistically significant ($P = <.01$).

always had giant cells; the same was not true of the lesions from which acid-fast bacilli were demonstrated by the smear technique. As indicated in Table I, nine of 56 smear-positive lesions were devoid of giant cells. Since positive smears for acid-fast bacilli reflect large numbers of tubercle bacilli in the lesions, it would appear that the number of organisms, *per se*, is not the sole factor governing the relative number of giant cells. The giant cell population appears to be related to the presence of viable tubercle bacilli. The reason for this is unknown.

The average duration of chemotherapy was longer with lesions having non-viable bacilli (189 days) than in the lesions with viable bacilli (121 days).

Comment

An attempt has been made to evaluate the significance of Langhans' giant cells in human tuberculosis by a simultaneous histologic and bacteriologic study of localized pulmonary nodules obtained by resectional surgery. By limiting the study to small solid lesions, one is assured that the bacteriologic and histologic specimens were anatomically related.

Smears of the resected non-cavitary lesions were more often positive for tubercle bacilli than cultures or guinea pig inoculations. This discrepancy has been attributed to chemotherapy as well as to the bacteriostatic effect of necrotic tissue products. The present study is in agreement with the experience of others in regard to the frequent non-viability of tubercle bacilli under these conditions in spite of their persistence on smears.[3-6, 8, 9, 11]

Arbitrary grading of the tuberculous lesions, using the presence of Langhans' giant cells as the criterion, separated a group of lesions (Group I) devoid of both giant cells and viable tubercle bacilli. It is noteworthy that although 47 per cent of the specimens in Group I contained acid-fast bacilli by smear, none contained viable tubercle bacilli. As mentioned earlier, previous detailed histologic studies of 94 unselected tuberculous

nodular lesions showed a high degree of correlation between bacterial viability and the "activity" of the lesion as judged by the pathologist.[11]

The concept that viable tubercle bacilli stimulate the proliferation of giant cells has been proposed previously.[2, 7] The above data would support such a concept. Most giant cells, however, do not contain visible acid-fast bacilli.[10, 12] Giant cells are not necessarily all active phagocytes.

The 19 tuberculous lesions which were devoid of giant cells did not yield acid-fast bacilli which would multiply even though nine of these lesions showed acid-fast bacilli by the smear technique. This information suggests that in localized, non-cavitary, tuberculous lesions the absence of giant cells in some way is related to the inability of the tubercle bacilli to multiply.

Recently Denst reviewed the histopathology of far-advanced tuberculous lung lesions in five patients following isoniazid therapy.[13] He reported numerous atypical foreign body type giant cells, frequent liquefaction of cavity contents and intense infiltration of tuberculous nodules with neutrophilic leucocytes. The present study includes only a few patients receiving isoniazid and there was no open cavitary lesion. Foreign body type giant cells were not numerous in our material. Neutrophilic leucocytes were seldom striking in the tuberculous nodules. Both the material and the histologic findings were quite different from those of Denst.

SUMMARY

Ninety-one surgically resected, non-cavitary tuberculous nodules with the greatest diameter not exceeding 2.5 centimeters were selected for histologic and bacteriologic analyses. Nineteen were characterized by almost complete absence of giant cells (Group I). The remainder (Group II) contained from a few to many giant cells in each paraffin section.

Although 47 per cent were positive by smear, none of the tuberculous lesions in Group I yielded viable acid-fast bacilli by culture or guinea pig inoculation. However, 31 per cent of the lesions in Group II contained viable acid-fast bacilli. This difference is statistically significant.

Within Group II no significant correlation was noted between the relative numbers of giant cells and the frequency of bacillary viability.

It is suggested that the absence of giant cells within a localized tuberculous nodule is related to the inability of the acid-fast bacilli within that nodule to multiply. Previous studies have shown that other evidences of histologic "activity" are also related to the viability of the tubercle bacilli.

RESUMEN

Noventa y un nódulos quirúrgicamente extirpados, con tuberculosis no cavitaria con diámetro, el mayor, de 2.5 cms. se escogieron para estudio bacteriológico e histológico. Diecinueve se caracterizaron la casi completa ausencia de células gigantes (grupo 1), el resto (grupo 2) contenían de pocas a muchas células gigantes en cada corte en parafina.

Aunque 47 por ciento fueron positivos al frotis ninguna de las lesiones tuberculosas del grupo 1, dieron bacilos viables por cultivo o inoculación

al cuy. Sin embargo, 31 por ciento de las lesiones del grupo 2 contenían bacilos viables, ácido resistente.

Esta diferencia es estadísticamente significante.

Dentro del grupo II no se encontró correlación significante entre el número relativo de células gigantes y la frecuencia de la viabilidad del bacilo.

Se sugiere que la ausencia de células gigantes en una lesión tuberculosa nodular está en rlación con la incapacidad del bacilo dentro de ese nódulo, para multiplicarse. Estudios previos han mostrado que otras evidencias de actividad "histológica" están también en relación con la viabilidad del bacilo de la tuberculosis.

RESUME

Les auteurs ont choisi 91 pièces après résection chirurgicale. Il s'agissait de nodules tuberculeux non excavés, dont le diamètre principal ne dépassait pas 2 cm., 5. Ces pièces furent soumises à un examen histologique et bactériologique. 90 étaient caractérisée par l'absence à peu près complète de cellules géantes (groupe I). Les autres (groupe II) contenaient des cellules géantes dans chaque bloc de paraffine en quantité variable. Dans certains cas, il y en avait peu, dans d'autres, elles étaient très nombreuses.

Bien que 47% des cas contenaient des bacilles de Koch sur lames, aucune des lésions tuberculeuses du groupe I ne permit de mettre en évidence des bacilles acido-résistants viables, par cultures ou inoculations au cobaye. Toutefois, 31% des lésions du groupe II renfermaient des bacilles acido-résistants viables. Cette différence est statistiquement valable.

Permi les pièces du groupe II, les auteurs ne constatèrent pas une relation évidente entre la quantité des cellules géantes d'une part, et la viabilité des bacilles d'autre part.

Les auteurs émettent l'hypothèse que l'absence de cellules géantes dans un nodule tuberculeux est en relation avec l'impossibilité de la multiplication des bacilles acido-résistants dans ce même nodule. Des études antérieures ont montré que d'autres signes manifestes de lésions histologiquement actives se retrouvent parallèlement à l'existence de bacilles tuberculeux viables.

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Adrenocorticotrophic Effect of Intravenous PAS and Its Therapeutic Implications

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Several reports have lately drawn attention to the increased therapeutic efficiency of Para-aminosalicylic acid (PAS) when administered in the form of short intravenous perfusions. Paraf et al (1951 A. and B. 1952) as well as Duroux and Coletsos (1951) credit the method with unparalleled results in the treatment of fresh ulcerocaseous types of pulmonary tuberculosis. Our own experience with intravenous PAS therapy proved equally satisfactory; in a large percentage of our cases, marked clinical improvement accompanied by radiological evidence of closure of the cavities with a minimum of fibrotic scar-tissue formation was observed within three weeks of the initiation of the perfusions (Favez et al. 1952).

According to Paraf et al the superiority of intravenous PAS over its oral form of administration would result mainly from the transitorily higher blood concentration of the drug allowing its crossing of the so-called "pericavitary barrier" and the achievement of an effective level in situ. However this assumption of a relative impermeability of the cavitary wall to PAS was not borne out by Wolfart's determinations of the PAS content of cavity excretions in a number of cases treated with Maurer tamponade or Monaldi drainage and receiving the conventional oral dose of the drug: in all cases the required minimum concentration of 0.001 mg./ml. was exceeded (Wolfart, 1951). It appeared doubtful moreover that the effects of intravenous PAS could be ascribed solely to the enhancement of its bacteriostatic activity; the association to the latter of an ACTH or cortisone-like antiinflammatory property was suggested by the rapid clearing of the lesions and the afibrotic nature of the regenerative process evidenced by the roentgen pictures in many of our patients perfused with PAS (Fortier and Favez, 1952). Indeed closely related compounds, such as salicylates and acetyl-salicylic acid, were shown to possess, in common with so-called stressing agents (Selye, 1950), a marked ACTH-releasing activity in man (Costa and Ferrari, 1951; Eser and Sipahiöglu, 1951; Kelemen and Majoros, 1951; Pasqualini, 1951; Roskam et al. 1951; Tronchetti and Nello, 1951) as well as in the experimental animal (Cronheim et al. 1952; Jacot et al. 1951; Kelemen et al. 1950; Pasqualini et al. 1950; Van Cauwenberge, 1951 A and B; Van Cauwenberge and Betz, 1952; Van Cauwenberge et al. 1951). A similar activation of the pituitary-adrenal axis, appraised by the consequent fall of adrenal cholesterol and ascorbic

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acid, was observed to follow the intraperitoneal administration of large doses of PAS in the guinea-pig. On the other hand, orally administered PAS failed to alter in man the urinary excretion of 17-keto and 11-oxysteroids (Van Cauwenberge et al. 1951). The lower blood level of the drug, achieved through oral administration, might explain these apparently conflicting results as well as the difference observed between the effects of oral and intravenous PAS therapy. It was the object of the present study to elucidate this point by comparing the adrenocorticotrophic effect and the related antiinflammatory activity of the two routes of administration.

Experimental Procedure

A. Subjects and Treatment

A group of twelve young (18-23 years old) female tuberculous patients, presenting recent and fairly localized pulmonary lesions, were submitted to strict bed rest and to an identical diet during this study which extended over a period of 27 days. Every form of therapy had been interrupted 10 days prior to the onset of the experiment. The patients remained untreated for an additional week in the course of which preliminary tests were carried out in order to obtain control values. From the eighth to the 18th day, PAS (coated tablets of aminacyl) was administered orally at a daily dosage of 15 gm. absorbed at a single one-hour session (between 8 and 9 A.M.) by one half of the patients, while the others received it in three equal portions at 8 A.M., 3 and 10 P.M. respectively. During the last 10 day period (18th to 28th day), PAS was administered (between 8 and 9 A.M.) in the form of one-hour intravenous perfusions of 18.5 gm. of the NA-salt (equivalent to 15 gm. of the free acid) dissolved in 500 cc. of bidistilled water.

B. Tests

The fall of the circulating blood eosinophils and lymphocytes, and the development of a resistance to the hypoglycemic action of insulin were used as indices of pituitary-adrenal stimulation (Fortier, 1952; Sayers, 1950) and repeated twice weekly. The effect of PAS on the local inflammatory reaction was appraised by means of a specially devised cantharidine test to which the patients were submitted during their untreated stage and at the end of the two following periods of oral and intravenous PAS therapy.

a) Eosinophils and Lymphocytes.

At 8 A.M. and 12 (noon) while the patients were untreated, immediately before and four hours after the ingestion of PAS (single daily dose of 15 gm. or first portion of 5 gm.) or the beginning of the perfusion, as the case might be, direct counts of the eosinophils were performed on samples of capillary blood from the fingertip according to the propyleneglycol method described by Randolph (1949). Uniform hemocytometer white pipettes were utilized. The mixing of the blood was standardized by the use of a pipette-shaker, and the eosinophils were counted in the 16 large millimeter squares of four Hellige-Neubauer chambers of 0.2 mm.

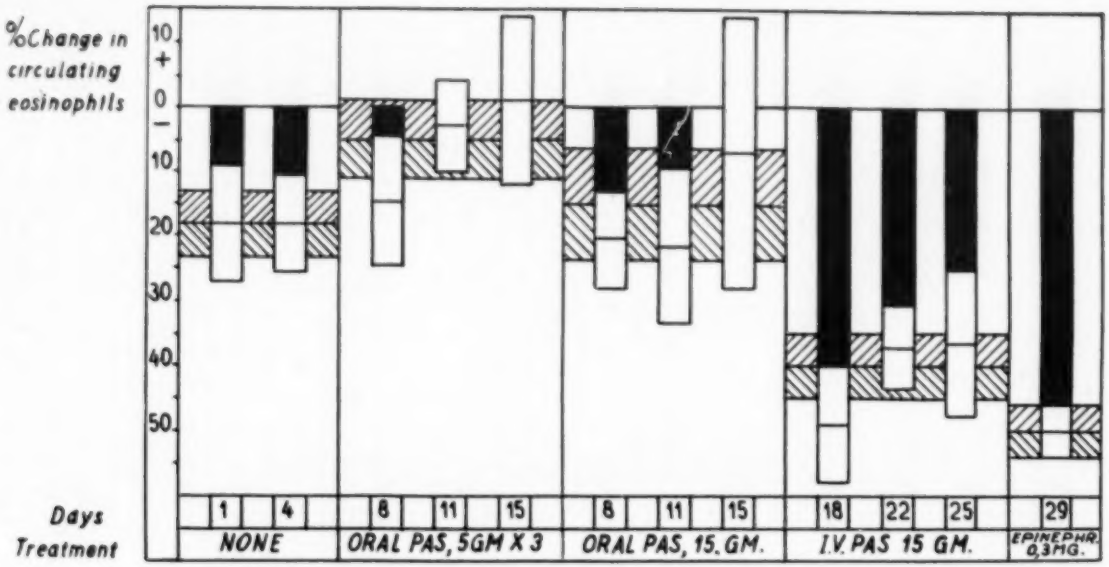

FIGURE 1: Comparative effect of epinephrine and of PAS administered orally and in the form of short intravenous perfusions on blood eosinophils. In this as well as in the following graphs, the results of each series of determinations are represented by columns, the white section of which corresponds to the standard error of the mean. The mean is itself indicated by the dividing line. The standard error and the mean of all the values recorded during a given period of treatment are illustrated by parallel arrows and their shafts.

depth (Thorn et al. 1949). There being no reliable method for the direct counting of the lymphocytes, their proportion was determined, at the same time intervals, by differential counts of May-Grümwald-Giemsa stained smears. Our results were expressed in both cases as percentages of fall from the initial (8 A.M.) level.

b) Insulin test.

The patients were allowed no food after 8 P.M. on the day before the test. At 10:30 A.M. on the following day, 16 units of crystalline insulin were injected intramuscularly. Blood samples (0.1 ml.) were collected from the finger-tip immediately before and 30, 60, 90 and 150 minutes after the injection, for blood glucose determination by the micro-method of Folin-Malmros (1929) modified for photometric reading at 520 A°. The results were expressed as percentages of maximal fall from the fasting blood glucose level.

c) Cantharidine test.

Advantage was taken, in this test, of the protective effect of ACTH and cortisone against changes in capillary permeability (Benditt et al. 1950; Geyer and Keibl, 1952; Grenell and McCawley, 1947; Prados et al. 1945), and of their known ability to inhibit or depress the migration of the leucocytes to the area of local irritation (Ducommun, 1952; Ebert, 1952; Rebuck et al. 1951 A and B). Any increase in the endogenous production of these hormones under the influence of stress would be expected, on that basis, to reduce the cellular and total protein content of an artificially produced exudate. A 0.4 per cent mixture of cantharidine in a waxy medium was chosen for that purpose.* It was packed into an ebonite capsule, 2 cm. in diameter, the free end of which was applied to the anterior aspect of the forearm. The capsule was loosely immobilized in the position and left in contact with the skin for an overnight period of 10 hours. It was removed at 8 A.M. and the resulting blister was allowed to expand until 12 (noon) when it was carefully punctured, and the exudate aspirated into a syringe. The volume was recorded and a white blood cell count was performed extemporaneously. Following centrifugation, the total protein content of the supernatant fluid was determined photometrically according to Leitz's modification (1948) of the method originally described by Greenberg (1924).

Results

In order to facilitate the interpretation of the results summarized in the accompanying graphs, we shall deal only, to the exclusion of individual series of determinations, with the averages of the values recorded during given period of treatment.

1. *Eosinophils.*

A slight fall of the eosinophils (Fig. 1) was observed even while the patients were untreated. No significant difference** was noted following

*A similar cantharidine mixture was used by Kepecs et al. (1951) to produce an inflammatory reaction which they devised to study the effects of psychological factors upon the rate of exudation. (According to Wünsche [1954] the cantharidine test has been originally described by E. Kaufmann [*Krkh. forsch.*] 2, 372 [1926]; 3, 263 [1926]).

the oral administration of either 5 or 15 gm. of PAS. The patients reacted, on the other hand, to the intravenous perfusions of 15 gm. of PAS with a marked (40 per cent) and statistically significant eosinopenia, which is comparable with the 50 per cent fall induced by the subcutaneous injection of 0.3 mg. of epinephrine HCE.

2. *Lymphocytes.*

The lymphocytes (Fig. 2) likewise failed to respond to orally administered PAS, but showed a statistically significant fall in response to PAS perfusions. This fall is of lesser magnitude than the corresponding decrease of the eosinophils; which is in agreement with the observations of Forsham et al. (1948) on the comparative reactivity of the two indices.

3. *Resistance to Insulin.*

A stepwise decrease of the hypoglycemic reaction to insulin (Fig. 3) was observed during the successive phases of PAS therapy. The patients proved normally sensitive to insulin following the ingestion of the partial dose of 5 gm., significantly less so when the total dose of 15 gm. was absorbed at one time, and truly resistant when it was perfused; the blood glucose fall induced by insulin being then reduced to 2/3 of the normal.

4. *Reaction to Cantharidine.*

The volume of the exudates collected from the cantharidine-induced

**Fisher's test of significance was applied. The difference between two means was considered significant when $\frac{D}{ED} > T$, as recorded in the tables of T for P = 0.05

where D = Difference

ED = Standard error of the difference $\sqrt{E^2a + E^2b}$

E = Standard error of the mean $\sqrt{\frac{\Sigma (Y-M)^2}{N(N-1)}}$

Y = Variable

M = Mean

N = Number of variables (from Patterson, 1939).

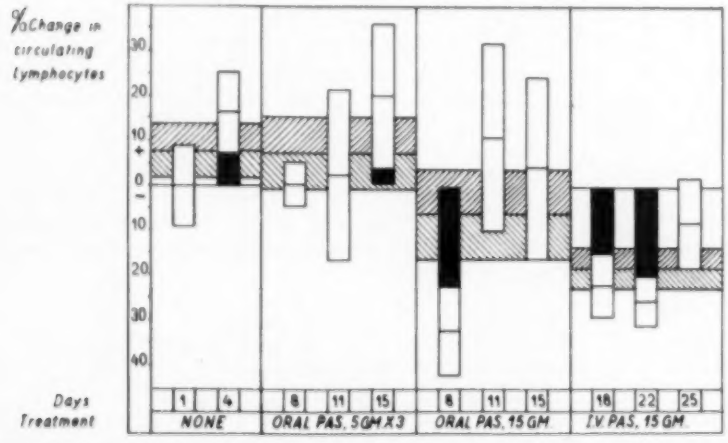

FIGURE 2: Comparative effect of oral and intravenous PAS administration on blood lymphocytes.

blisters averaged 1.4 ml. in the untreated patients and was not altered by PAS administration. However both the total protein and the white blood cell contents of the exudates (Fig. 4) were significantly decreased by PAS perfusions, and, to a lesser extent, by the oral administration of 15 gm. of PAS at one time. The same dose of PAS given in three portions of 5 gm. proved less effective, although similarly oriented changes were noted during that phase of the treatment.

5. *Other Data.*

An average body weight gain of 700 gm. was recorded during the preliminary week of observation; it was lost during oral PAS therapy and recovered during the period of PAS perfusions. Neither the erythrocyte sedimentation rate nor the fasting blood glucose level or the blood formula evidenced any changes worthy of mention.

Discussion and Conclusions

The effect exerted by PAS on the circulating blood eosinophils and lymphocytes, insulin sensitivity and topical inflammatory reaction proved directly related to the mode of administration of the drug. It was marked as a result of the perfusions, from slight to insignificant following a single oral dose, and absent when the latter was divided into three spaced portions.

It should be mentioned, however, that while the peak of the PAS concentration in blood is attained at the end of the perfusion, it is delayed by two hours or more when the drug is ingested (Probst et al 1952; Rieber et al 1951). Our experimental time arrangement being better suited to the detection of early effects, the adrenocorticotrophic activity resulting from the ingestion of the undivided dose of PAS may thus have been underestimated. The above results nonetheless support our contention regarding the ACTH-releasing effect of PAS when its concentration in blood

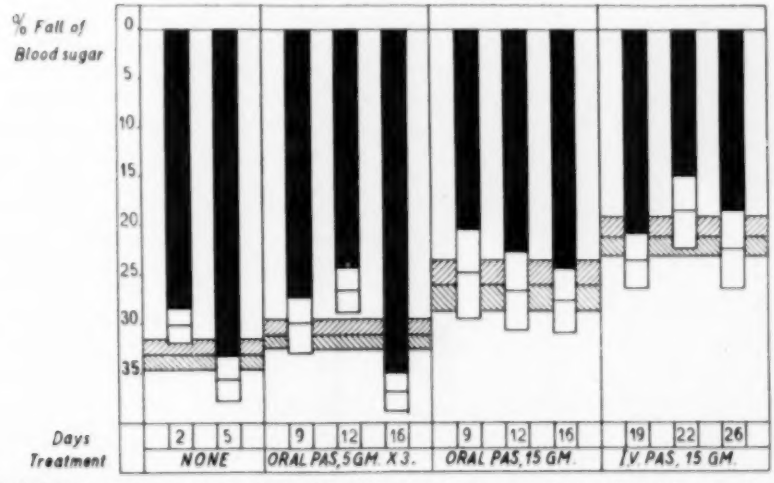

FIGURE 3: Comparative effect of oral and intravenous PAS administration on the hypoglycemic response to insulin.

exceeds the level afforded by conventional oral administration.* The anti-inflammatory property of intravenous PAS is presumably not alien to this effect which it closely paralleled in our study. It is therefore tempting to attribute, at least in part, to the nonspecific activation of the pituitary-adrenal axis the therapeutic superiority of the perfusions over the oral form of PAS administration. In order to further elucidate the causal nature of this relationship, it would appear of interest to assess the therapeutic value of the association to oral PAS or to streptomycin of non-specific stressing agents which would duplicate the ACTH-releasing effect of the perfusions. Particularly relevant are the claims of Aleksandrowicz (1950) regarding the beneficial effects of combined streptomycin-nitrogen mustard therapy in cases of exudative pulmonary tuberculosis. Our own experience with the use of either cortisone (Delaloye and Favez, 1953; Aguet and Favez, 1954) or non-hormonal anti-inflammatory agents (Favez et al, in press) has been so far highly satisfactory in the treatment of fresh cases of acute and rapidly progressing pulmonary tuberculosis. We suggest that the wise and discriminating use of this form of therapy warrants serious consideration in the aforementioned selected cases.

ACKNOWLEDGMENT

This investigation was generously subsidized by Dr. A. Wander A. G., Bern.

*Before this paper was submitted for publication, a report has appeared (Roskam et al. 1953) which corroborates our observations regarding the eosinopenic effect of intravenous PAS. We are grateful to Professor Roskam for supplying us with further unpublished data from his laboratory, which are in agreement with our findings.

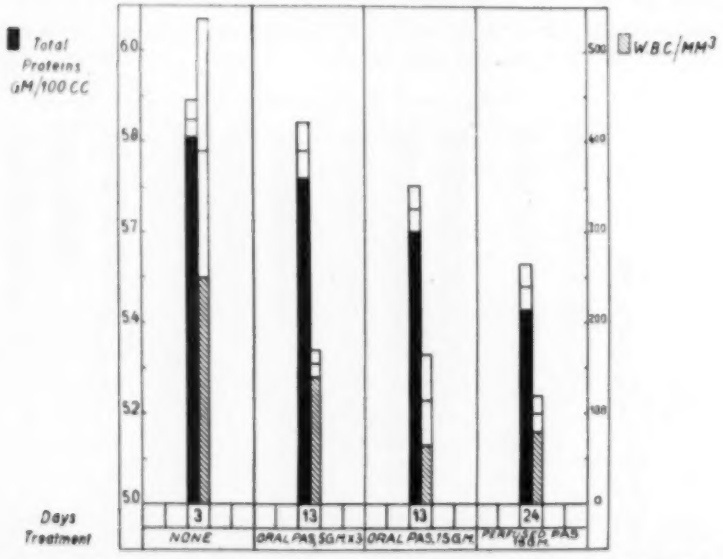

FIGURE 4: Comparative effect of oral and intravenous PAS administration on the total protein concentration and the white blood cells content of an exudate collected from cantharidine-induced blisters.

SUMMARY

With a view to explain the therapeutic superiority of short intravenous perfusions of PAS over its oral form of administration in pulmonary tuberculosis, a comparative study of the ACTH-releasing effect of the two routes of administration was conducted in 12 young female tuberculous patients. They were successively treated with 15 gm. of sodium PAS administered orally in either one massive dose or three spaced portions, and with one-hour intravenous perfusions of the same amount, dissolved in 500 cc. of bidistilled water. The effect of PAS on the circulating blood eosinophils and lymphocytes, hypoglycemic response to insulin and inflammatory reaction to cantharidine, which were used as indices of pituitary-adrenal activation, proved directly related to the mode of administration of the drug. It was marked as a result of the perfusions and slight or absent following oral administration. It is concluded that the higher blood concentration of intravenously administered PAS acts as a stressing agent and induces the release of ACTH from the pituitary. The consequent antiinflammatory property of intravenous PAS perfusions is tentatively correlated with their therapeutic efficiency.

RESUMEN

Con la mira de demostrar la superioridad de la vía intravenosa de aplicación del PAS sobre la forma oral en tuberculosis pulmonar, se hizo un estudio de comparativo del efecto liberador del ACTH las vías de aplicación en 12 mujeres jóvenes tuberculosas.

Fueron sucesivamente tratadas con 15 gmos. de PAS sódico oral ya en una dosis masiva o en tres dosis separadas; y en comparación la misma cantidad inyectada intravenosamente en una hora, disuelta en 500 cc. de agua bidestilada.

El efecto del PAS en los eosinófilos circulantes y en los linfocitos, a respuesta hipoglicémica a la insulina y la reacción inflamatoria a la cantaridina que fueron usados como índices de activación pituitario-adrenal, se mostraron directamente en relación con la vía de administración de la droga.

Es marcada la respuesta como resultado de la perfusión y ligera después de la ingestión. Se concluye que la más alta concentración del PAS administrado por las venas, actúa com un agente de esfuerzo—(stress) e induce la liberación de ACTH de la pituitaria. La propiedad anti-inflamatoria consecutiva a las inyecciones intravenosas de PAS se intenta corelacionar con su eficiencia terapéutica.

RESUME

Les auteurs ont cherché à expliquer la supériorité thérapeutique dans la tuberculose pulmonaire de courtes perfusions intra-veineuses de PAS sur l'administration de ce produit par voie buccale. Dans ce but, ils ont étudié chez 12 jeunes femmes atteintes de tuberculose le rôle dans la libération de l'ACTH de ces deux différentes voies d'administration.

Les malades furent successivement traitées par 15 grammes de PAS sodique par voie buccale soit en une seule dose massive, soit en trois prises espacées, et par des perfusions intra-veineuses d'une heure de la même

quantité de produit dissous dans 500 cc. d'eau bidistillée. Les auteurs constatèrent que l'action du PAS sur les éosinophiles et les lymphocytes du sang, la réponse hypoglycémique à l'insuline, et la réaction inflammatoire à la cantharidine (qu'ils utilisèrent comme indices de l'activation hypophysaire de la surrinale, étaient directement en rapport avec l'administration de la drogue. Elles étaient marquées lorsqu'il s'agissait de perfusions, et légères ou absentes à la suite de l'administration par voie buccale. Les auteurs concluent que la concentration la plus élevée de PAS administrée par voie intraveineuse agit comme un agent "stressant" et provoque la libération d'ACTH de l'hypophyse. Ils tentent de rapporter l'efficacité thérapeutique des perfusions intraveineuses à leurs propriétés antiinflammatoires.

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Extrafascial Subscapular Wax Prosthesis in Dogs

A Study of Regeneration of Bone and the Fate of Denuded Ribs Following the Mobilization and Depression of Periosteum by Extrafascial Wax Prothesis.*

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Although collapse therapy is less frequently indicated in the surgical treatment of pulmonary tuberculosis, this form of management is still useful in some types of lesions. For this surgery a single stage operation with a selective type of complete collapse is desirable. This paper deals with the experimental aspect of an operation designed for this purpose,[1-3] i. e., the use of an extrafascial paraffin pack left in the subscapular space after selected removal of ribs in the treatment of pulmonary tuberculosis. The operation also has been used to collapse the chest wall over an infected empyematous space after pulmonary resection and also as a means of partially obliterating the pleural space following pneumonectomy in order to avoid overdistention of the remaining lung as well as to reduce the potential hazard of empyema.

The principal object of this experiment was to study the regenerative capacity of the periosteum which had been stripped away from the ribs and was maintained under pressure by the wax pack. This information would enable one to determine how long after the wax prosthesis was inserted it would be safe to remove it without having undesirable reexpansion of a diseased and up to then collapsed lung. Further, it was desirous to observe any changes which took place in the ribs which had been denuded of their periosteal covering.

Description of the Technique

Sixteen mongrel dogs weighing from nine to 16 kilograms were used. The operation was performed in the following manner: through a posterolateral incision the superior half of the costal frame was exposed by retracting the scapula upward and forward. The fifth rib was deprived of its periosteum circumferencially from about three to four centimeters from the costochondral junction back to approximately three centimeters from the tip of the transverse process; over this area the rib was completely denuded. The inner surface of the fourth rib was deprived of its periosteum over a shorter length by incising the periosteal sheath at both the upper and lower edge of the rib. The periosteum of the inner surface of the third rib was elevated by incising at only the inferior edge of the bone (Figure 1A). In this triangular bed with its base in the fifth

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*From the Department of Surgery of the University of Chicago.

interspace and its apex in the second interspace a wax pack weighing from 85 to 110 grams was inserted. Over this plombe were the ribs; under it lay the stripped off periosteum and the intercostal muscles (Figure 1B). The serratus posticus muscle insertions on the fourth and third ribs were left untouched. The wound was closed in layers with catgut. In six dogs the operation was performed on both sides making a total of 22 operations.

The follow-up period extended from ten days to fifteen months. In six dogs the wax was added with 20 cc. of iodochlorol to increase the radio-opacity. In seven animals the paraffin extruded and the cutaneous draining sinuses became secondarily infected. Six of these were in the iodochlorol experiments. Periodic chest x-ray films were taken (Figure 2a and b). One dog was discarded at two months because of a testicular tumor that deteriorated the general condition. Another died the following day when given barbiturates for taking the chest film. One died six days postoperatively because of respiratory insufficiency; a huge hydrothorax and the wax prosthesis were found in the pleural cavity. A fourth one died one day following a second operation which was four months after the first operation. On the side of the last operation an empyema and an atelectatic lung as well as pieces of wax were found. A fifth one died 11 days after the operation; the subscapular space was infected and pneumothorax was present. The remaining 11 dogs were sacrificed from three to 15 months postoperatively.

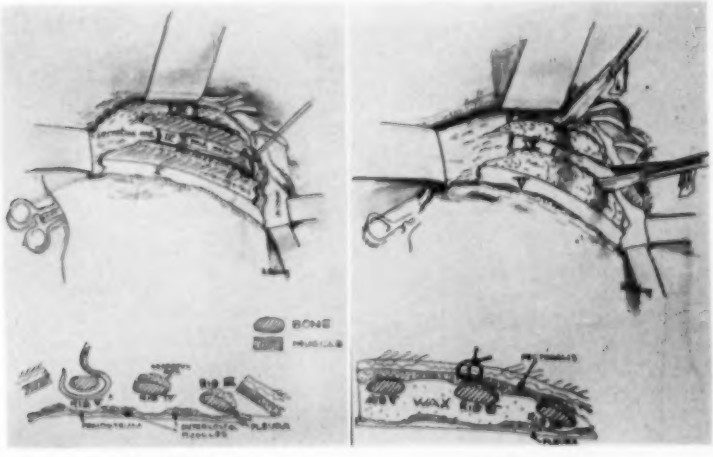

FIGURE 1A FIGURE 1B

Figure 1A: Drawing of chest wall of operative procedure used in dogs for making an extrafascial subcostal paraffin pack. At the top is illustrated the manner in which the periosteum was stripped away from the ribs. The fifth rib was deprived of its entire periosteal sheath. In the case of the fourth and third ribs the outer periosteal covering was preserved, only the inner portion of the sheath being mobilized and depressed by the wax pack. Below is illustrated a cross section of the chest wall showing what has been described above.—*Figure 1B:* Drawing of chest wall following introduction of wax into the extrafascial subscapular space created for it. Note depression of innercostal structures along with the periosteum over the area created for the wax.

Protocol of Dog No. 933. Operation performed in the manner above described on April 6, 1951. This first operation was on the left side. The postoperative course was uneventful. A similar operation was made on the right side on April 24, 1951. The wax of this second operation was mixed with iodochlorol. An x-ray film showed that the wax packs were in place. The right wound developed an infection and started to drain; wax came out through the draining sinus. A chest x-ray film on October 16, 1951 revealed the wax pack on the left side (the first) to be in good place; the one on the right had disappeared. The animal was sacrificed on July 22, 1952; the pack on the left was intact and in place; poor regeneration of bone. The wax on the right had escaped out through the drainage tract; good regeneration of bone.

Results

The costal frame was removed enmass and sections of the entire specimen were made (Figure 3 and 4). In this manner both the original and new formed ribs could be studied in the same slide. The wax was found as an even mass surrounding which there was a capsule of fibrous tissue from three to 18 millimeters thick. Around this was an infiltration of inflammatory cells, mainly lymphocytes. The original ribs whose periosteum had been removed appeared to be grossly of the same size as those whose periosteum had been left intact and on microscopic section showed normal viable bony structure (Figure 5A). A new fibrous sheath

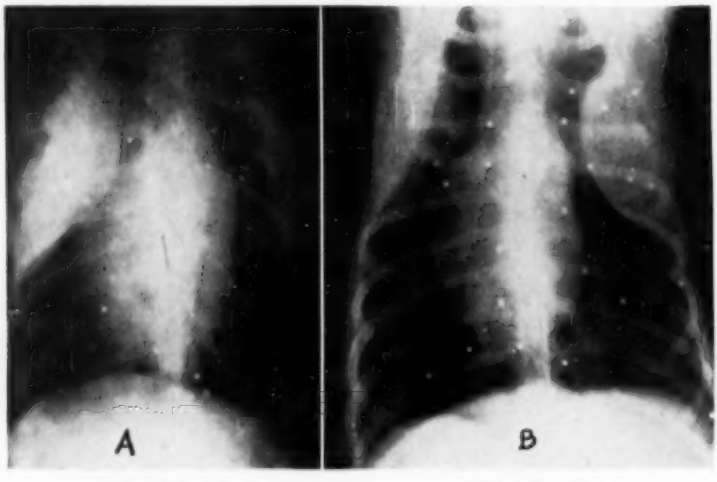

FIGURE 2A FIGURE 2B

Figure 2A: Dog 211. X-ray film of the chest 12 weeks following the insertion of the extrafascial wax pack beneath the third, fourth and fifth ribs. Note bulging of wax between the ribs laterally indicating the great tension on which the wax has been placed.—*Figure 2B:* X-ray film of the chest 40 weeks following the incision of an extrafascial wax pack in the left chest. Note that the wax pack on the right has largely disappeared due to extrusion of the wax and through an infected wound.

TABLE I

SUBCOSTAL EXTRAFASCIAL PARAFFIN PROSTHESIS IN DOGS

A Study of the Fate of Ribs Denuded of Periosteum and the Regeneration of Bone by the Depressed Periosteum.

	Dog #	Side of Operation	Duration in Weeks	S. or D. *	Complications	Results of Regeneration
1	933	L	60	S	None	None
2	933	R	44	S	Infection	Good
3	474	L	12	S	Infection Testicular tumor	None
4	586	L	20	D	None	Good
5	586	R	2	D	Pleural tear. Collapsed lung	None
6	960	L	1 day	D	Anesthesia	None
7	558	L	16	D	Pleural tear. Empyema	None
8	558	R	1 day	D	None	None
9	151	R	56	S	Infection	Fair
10	151	L	44	S	None	Fair
11	211	R	56	S	None	Good
12	211	L	44	S	None	Fair
13	463	R	6 days	D	Hydrothorax	None
14	533	L	93	S	Infection	None
15	533	R	12	S	None	Fair
16	617	R	44	S	None	None
17	981	L	52	S	None	None
18	433	L	20	S	None	Good
19	581	L	24	S	None	None
20	429	L	2	D	Infection Pneumothorax	None
21	575	R	12	S	None	None
22	96	R	24	S	None	Fair

*S-Sacrificed. D-Died.

Experiments 5, 6, 8, 13 and 20 are not included in the microscopic studies of the specimens because of the short follow-up period. Experiment 3 was discarded from the microscopic study because of the associated pathology which deteriorated the general condition.

was seen surrounding the ribs, thus replacing the periosteum which had been removed. The extracostal muscles were adherent to the outer surface of the fifth rib.

The character of the inner layer of the capsule surrounding the wax was variable; this was because of the presence or absence of new bone formed from the periosteum that was lying beneath the wax. The specimens as far as regeneration was concerned could be divided in three groups: 1) those in which no regeneration occurred; 2) those in which the regeneration was meager; and 3) those in which the regeneration was

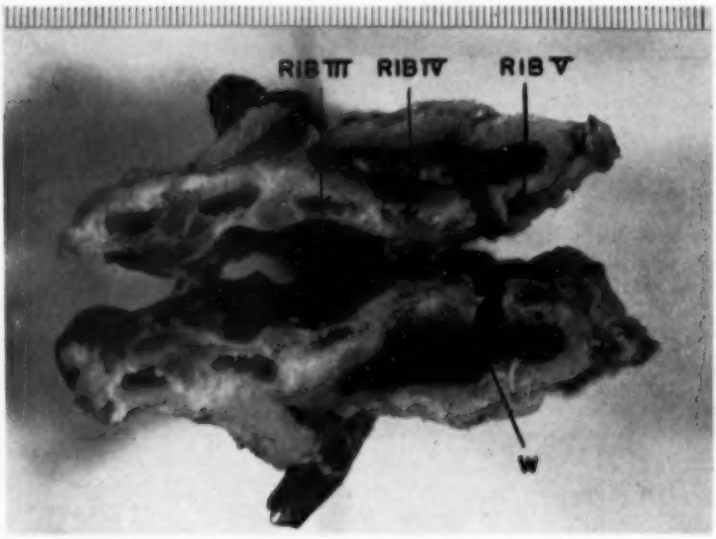

Figure 3: Dog 586. Photograph of chest wall including the enclosed wax pack (W) in an animal sacrificed 20 weeks following operation. Note space (W) where wax pack had been placed. A microscopic section was made of the entire chest wall in this area as seen in Figure 4.

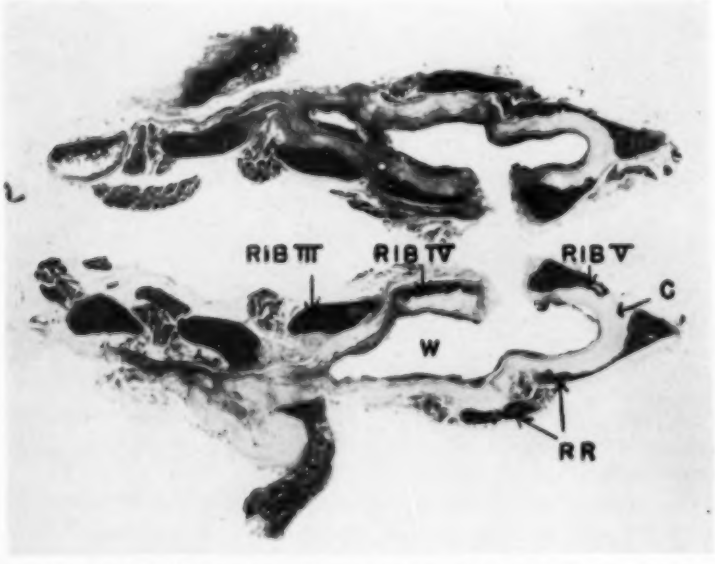

Figure 4: Dog 586. Microscopic section of entire chest wall at site of extrafascial wax pack. This area has been divided in the center thus showing two microscopic sections of the same field. Note good regeneration of bone (RR) where the periosteum of ribs No. 4 and 5 was mobilized and depressed by the wax pack. Also note connective tissue capsule (C) surrounding area of wax pack.

good (Figure 5B). There was no apparent relation between the regeneration of bone and the time elapsed up to the death of the animal. An example of this was in dog No. 933: (see protocol) the specimen from the left side was 15 months old when the animal was sacrificed and in it there was no evidence of regeneration; the one from the right side of this same animal was 10 months in duration, and it showed good regeneration. Another factor to be considered was the pressure of the wax: this was about the same in all cases; in those dogs where leakage of wax and as a consequence, relief of pressure had occurred, there was no correlation between the findings of new bone formation and the pressure factor. In most of the specimens the intercostal muscles failed to show changes that could be attributed to pressure. The degree of denudation of the periosteum has, we think, less value because the prompt and good regeneration in all cases of conventional type of thoracoplasty is well known. Special inter-reaction between the wax and the living tissues was questionable since in several dogs a very good regeneration of bone was found on one side of the chest while on the opposite side it was completely absent. Of the specimens studied, good regeneration was found in five, meager regeneration in four, no regeneration in seven.

In those cases with a follow-up longer than three months, 56 per cent showed regeneration of bone; 31 per cent of which was good and 25 per cent was meager. In 44 per cent no regeneration was found. No cause

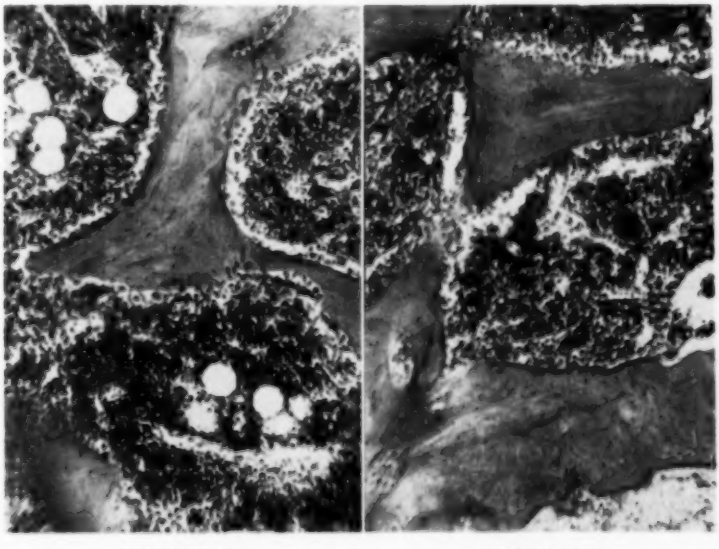

FIGURE 5A FIGURE 5B

Figure 5A: Dog 586. Microscopic appearance (250X) of rib denuded of periosteum 20 weeks following operation. Note viable bone cells and bone marrow.—*Figure 5B:* Dog 586. Microscopic (250X) appearance of regenerated bone from mobilized and depressed periosteum from fifth rib 20 weeks following operation. Note similar appearance to original bony structure as seen in Figure 5A.

has been found that could explain the inability of the periosteum in certain cases to regenerate new bone.

CONCLUSION

A study has been presented in which the periosteum of the third, fourth and fifth ribs in either side was stripped in an especial manner and a wax pack was placed between the ribs above and the periosteum and intercostal structures beneath. It was done in an attempt to determine the ability of the periosteum, placed under these circumstances, to regenerate new bone. In 56 per cent of the cases studied formation of new bone was found. No casual factor that could explain the lack of regeneration was found. Ribs whose periosteum had been denuded showed neither gross nor miscroscopic changes from the normal. Several factors that could possibly influence the regeneration of bone are 1) pressure, 2) infection, 3) duration of the collapse and 4) chemical reaction of the wax.

The results of these experiments support the clinical impression that little hazard attends leaving of ribs intact following complete denudation of their periosteum.

CONCLUSIONES

Se ha presentado un estudio de casos en los que el periostio de la tercera, cuarta y quinta costillas en ambos lados, fué despegado de manera especial y se colocó un relleno de parafina entre las costillas de arriba y el periostio y las estructuras intercostales debajo. Esto se hizo con afán de determinar la capacidad-del periostio colocado en semejantes circunstancias para regenerar hueso. En 56 por ciento de los casos estudiados se encontróformación de hueso nuevo. No se descubrió factor casual que pudiera explicar la falta de regeneración. Las costillas desprovistas de periostio no mostraron cambios macro o microscópicos. Varios-factores que podrían influir en la regeneración del hueso son: 1. presión; 2. infección; 3. duración del colapso; y 4. reacción química de la parafina.

Los resultados de estos experimentos respaldan la impresión clínica de que pequeño riesgo resulta de dejar las costillas intactas después de desnudarlas de su periostio.

RESUME

Les auteurs rapportent un travail dans lequel ils ont dénudé le périoste des 3ème, 4ème et 5ème côtes, aussi bien à droite qu'à gauche, d'un façon particulière. Ils ont introduit entre la côte d'une part et le périoste et les éléments intercostaux d'autre part, un enduit cireux. Ce procédé a été utilisé dans le but de déterminer la possibilité de régénération du périoste, placé dans de telles conditions. Dans 56% des cas étudiés, les auteurs ont pu mettre en évidence qu'il y avait une formation d'os nouveaux. Ils n'ont pas pu discerner quel est l'élément qui pouvait expliquer l'absence de régénération dans certains cas. Les côtes, dont le périoste avait été dénudé, n'ont montré aucune anomalie, ni à l'aspect macroscopique, ni à l'examen microscopique. Différents facteurs qui pourraient à la rigueur avoir une influence sur la régénération de l'os sont: 1.) la

pression 2.) l'infection 3.) le temps du collapsus 4.) l'action chimique de la cire.

Les résultats de ces expériences confirment l'impression clinique qu'il y a peu de chance que les côtes persistent dans leur intégrité après dénudation complète du périoste.

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Bronchial-Pulmonary Vascular Shunts in Chronic Pulmonary Affections*

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Introduction

Interest in the bronchial arteries, especially in their anastomoses with the pulmonary arteries, has greatly increased during recent years. The important developments in the diagnosis and treatment of congenital cardiac diseases has contributed to this in a large measure. In cases of pulmonary stenosis and pulmonary atresia the bronchial vascular system is markedly hypertrophied, and in atresia of the pulmonary valves, life can even be maintained in this way.

This hypertrophy of the bronchial arteries and their anastomoses with the pulmonary arteries has also been demonstrated experimentally by ligating a pulmonary artery in dogs and rats.[1, 2, 3, 8, 14, 16]

Originally the existence of these arterial anastomoses in the normal lung was denied,[17] but at present all doubts of this have disappeared as a result of accurate investigations,[10, 12, 14, 15, 16, 19] even though it is questionable whether they function under normal circumstances.

Hypertrophy of the bronchial arteries and their anastomoses with the pulmonary arteries is also present in various pulmonary affections. Of late years this has been investigated pathologic-anatomically.[4, 5, 6, 7, 9, 13, 16, 20, 21] Various interesting hypotheses have been advanced in connection with this [15, 16, 18] but clinically little attention has been paid to this so far.

The aim of the present investigation was to study to what degree the results of the pathologic-anatomical researches agreed with clinical experience. When in various pathological pulmonary processes hypertrophy of the bronchial arteries and opening and dilation of the anastomoses with the pulmonary arteries are observed, then it must be possible to demonstrate oxygenated arterial blood (originating from the bronchial arteries) in the pulmonary artery of the diseased part of the lung, through which normally mixed venous blood is flowing; and when a cardiac catheter is pushed up so far in the pulmonary artery of the diseased part of the lung that the vessel is occluded, it must be possible, under these circumstances, to record a pressure curve of the arterial type, because in this way the conducted pressure from the bronchial artery is measured. If in normal lungs the pressure is recorded in the same manner, a venous pressure curve is obtained, which reflects the pressure in the pulmonary vein, because it is assumed that the pulmonary arteries are functionally end-arteries. This pressure is called the 'pulmonary capillary' pressure.[11]

It is therefore possible by this method, using cardiac catheterization, to

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demonstrate a pathological connection of the systemic with the pulmonary circulation (left-right shunt), which must be of frequent occurrence.

Methods

Cardiac catheterization was carried out in the usual manner via the basilic vein or the saphenous vein. The catheter was manoeuvered into the pulmonary artery of the diseased part of the lung. Blood samples were taken at various places, and the pressure was measured by means of a modified Hamilton manometer. The oxygen saturation of the arterial blood was determined with the haemoreflector of Brinkman.[22] When the catheter was pushed upwards so far in one of the branches of the pulmonary artery of the diseased area of the lung that it could be assumed that this artery was completely occluded by the catheter, a pressure was measured called the "peripheral pressure" in this publication.

Material

Cardiac catheterization was carried out in a number of patients with chronic pulmonary diseases: tuberculosis, bronchiectasis, pulmonary cysts. In nearly all of them this was done as part of an extensive functional examination of pulmonary ventilation and circulation, to decide whether resection therapy was justified.

Results of the Investigation

TABLE I: S. E., FEMALE, AGE 35

On the left: destroyed lung, due to tuberculosis

Blood-sample from	Arterial Oxygen Saturation
	Percent
Brachial artery	94.5
Pulmonary artery, trunk	66
Pulmonary artery, right	69.5
Pulmonary artery, left	95
Pressure in:	
Pulmonary artery	40/15 cm. H_2O
Pulmonary artery left, peripherally	40/20 cm. H_2O (arterial curve)

TABLE II: TH. T., MALE, AGE 30

Areas of bronchiectasis in left lower lobe and lingula.

Blood-sample from	Arterial Oxygen Saturation
	Percent
Brachial artery	96
Right ventricle	70.5
Pulmonary artery, right	71.5
Pulmonary artery, lingula	94.5
Pulmonary artery, left lower lobe	81
Pressure in:	
Pulmonary artery	30/10 cm. H_2O

A good peripheral curve was not obtained.

TABLE III: H.v.d.H., FEMALE, AGE 46

Areas of bronchiectasis in left lower lobe, lingula and middle lobe.

Blood-sample from	Arterial Oxygen Saturation
	Percent
Brachial artery	94
Right ventricle	60
Pulmonary artery, right	58.5
Pulmonary artery, left lower lobe	94
Pressure in:	
Pulmonary artery	36/10 cm. H_2O
Pulmonary artery, lingula, peripherally	50/35 cm. H_2O (arterial curve)

TABLE IV: H. S., MALE, AGE 36

The entire left lung was bronchiectatic.

Blood-sample from	Arterial Oxygen Saturation
	Percent
Brachial artery	96
Right ventricle	67
Pulmonary artery, right	67
Pulmonary artery, left upper lobe	95.5
Pulmonary artery, left middle field	89
Pressure in:	
Pulmonary artery	40/15 cm. H_2O
Pulmonary artery, left upper lobe, peripherally	55/45 cm. H_2O (arterial curve)
Pulmonary artery, left middle field, peripherally	55/40 cm. H_2O (arterial curve)

TABLE V: T. S., FEMALE, AGE 33

Extensive tuberculosis of practically the whole right lung.

Blood-sample from	Arterial Oxygen Saturation
	Percent
Brachial artery	97
Right ventricle	70.5
Pulmonary artery, left	70
Pulmonary artery, right upper lobe	95
Pulmonary artery, right lower lobe	95
Pulmonary artery, right lower lobe centrally	78
Pressure in:	
Pulmonary artery	45/20 cm. H_2O
Pulmonary artery, right upper lobe, peripherally	85/65 cm. H_2O (arterial curve)

TABLE VI: J. S., MALE, AGE 40

Areas of bronchiectasis in right lower and middle lobe, left lower lobe and lingula.

Blood-sample from	Arterial Oxygen Saturation
	Percent
Brachial artery	94.5
Right atrium	63
Pulmonary artery, trunk	64
Pulmonary artery, right upper lobe	62.5
Pulmonary artery, middle lobe	94
Pulmonary artery, left lower lobe	92.5
Pressure in:	
Pulmonary artery	30/10 cm. H_2O
Pulmonary artery, middle lobe, peripherally	35/20 cm. H_2O (arterial curve)

TABLE VII: J. W., MALE, AGE 53

Areas of bronchiectasis in right lower lobe, middle lobe and anterior segment of upper lobe; left lower lobe, lingula and anterior segment of upper lobe.

Blood-sample from	Arterial Oxygen Saturation
	Percent
Right ventricle	61
Pulmonary artery, trunk	60.5
Pulmonary artery, right lower lobe	84
Pulmonary artery, right lower lobe, other branch	95
Pressure in:	
Pulmonary artery	35/10 cm. H_2O
Pulmonary artery, right lower lobe, peripherally	35/20 cm. H_2O (arterial curve)

TABLE VIII: A. V., FEMALE AGE 39

Whole left lung showed cystic and bronchiectatic changes. It was bronchospirometrically demonstrated that the oxygen uptake of the left lung was nil.

Blood-sample from	Arterial Oxygen Saturation
	Percent
Brachial artery	98
Right ventricle	71.5
Pulmonary artery, right	75
Pulmonary artery, left	97
Pressure in:	
Pulmonary artery	27/10 cm. H_2O
Pulmonary artery, left, peripherally	35/20 cm. H_2O (arterial curve)

TABLE IX: H. T., FEMALE, AGE 46

Cavitational tuberculosis in shrunken left upper lobe; patent foramen ovale.

Blood-sample from	Arterial Oxygen Saturation
	Percent
Femoral artery	96.5
Right ventricle	71
Pulmonary artery, trunk	71
Pulmonary artery, left upper lobe	97
Pulmonary vein, left upper lobe	94.5
Pressure in:	
Pulmonary artery	30/14 cm. H_2O
Pulmonary artery, left upper lobe, peripherally	30/24 cm. H_2O
A good peripheral curve was not obtained.	
Pulmonary vein, left upper lobe	17/0 cm. H_2O

TABLE X: M. S., MALE, AGE 30

Tuberculosis in shrunken left upper lobe, among other sites; atrioseptal defect.

Blood-sample from:	Oxygen Saturation:
	Percent
Superior vena cava	69
Inferior vena cava	75.5
Right atrium	78.5
Left atrium	92.5
Left ventricle	94
Right ventricle	76.5
Pulmonary artery, left	77.5
Pulmonary artery, left upper lobe	91.5
Pulmonary vein, left upper lobe	88
Pressure in pulmonary artery	35/15 cm. H_2O
A good peripheral curve was not obtained.	

TABLE XI: L.v.B., MALE, AGE 47

Destroyed lung on the left, due to tuberculosis. Blood-sample from	Arterial Oxygen Saturation
	Percent
Brachial artery	66
Right ventricle	41.5
Pulmonary artery, right	41.5
Pulmonary artery, left	49.5
Pressure in:	
Pulmonary artery	90/35 cm. H_2O
Pulmonary artery, left, peripherally	80/40 cm. H_2O (arterial curve)

Discussion

It impresses us in these observations that the oxygen saturation of the blood in the pulmonary arteries of lungs or lobes showing extensive changes due to tuberculosis or bronchiectasis, is equal to the oxygen saturation of the blood in the systemic circulation, or in any case definitely higher than the oxygen saturation of the mixed venous blood. This blood can only originate from the dilated bronchial arteries, which have formed wide anastomoses with the pulmonary arteries. The pressure in these pulmonary arteries proved also to be high when the catheter was pushed upwards so far that it occluded the artery, and thus it was possible to record an arterial pressure curve (peripheral pressure) in many cases. In normal lungs the "pulmonary capillary" pressure is measured in this manner, and here a clearly venous pressure curve is obtained which reflects the pressure in the pulmonary veins. In this study it was not always possible to obtain a good peripheral pressure curve, and this is understandable when we realize how tortuous the course of the bronchial arteries is in these cases, and how deformed the pulmonary arteries are. The high peripheral arterial pressure curves observed must be caused by the conduction of the pressure in the dilated bronchial arteries via the wide, open anastomoses with the pulmonary arteries.

The pressure in the pulmonary arteries of the affected lung or lobe did not show values higher than the pressure in the arteries of normal parts of the lung. This is explained by the enormous adaptability of the pulmonary vascular system, in which the pressure does not rise until the blood supply is increased more than threefold, which practically never occurs in normal individuals.

At present it is assumed that, in various pulmonary processes, the pulmonary artery is first thrombosed, that this causes a great increase in calibre of the bronchial arteries and their anastomoses, which probably do not function in normal cases, and that the pulmonary artery is then recanalized.[16]

In these pulmonary processes there is a markedly increased blood supply from the bronchial arteries via the anastomoses to the pulmonary arteries. This oxygenated blood from the systemic circulation flows partially via the normal route to the bronchial veins which drain into the pulmonary veins, and partially through the pulmonary capillaries (where, due to the

morbid process, there is no gas exchange) to the pulmonary veins, and thus arrives in the left heart again. This means in fact a left-right shunt. Another part of this oxygenated blood flows back into the pulmonary artery, where it can be demonstrated by means of the cardiac catheter. This back flow may sometimes even be so intense that the blood reaches the pulmonary arteries of the healthy part of the lung. However, in view of the saturation values found, this is not often the case, and only to a slight degree when it occurs.

In marked cases the amount of blood flowing through this left-right shunt has been estimated at over one third of the cardiac output.[1] This means that in these cases the cardiac output of the left heart is considerably greater than that of the right heart, which constitutes an extra strain on the left heart. These vascular left-right shunts in the lungs are by no means rare, but they must be present very frequently in more or less extensive form.

The blood flows from a high-pressure system (the systemic circulation) to a lower-pressure system (the pulmonary circulation) via the bronchopulmonary anastomoses. At the place where it drains into the pulmonary artery, this flow will form a barrier for the mixed venous blood from the right heart, with the result that no venous blood can flow through the diseased part of the lung where no oxygen can be taken up; this mechanism prevents an arterial undersaturation. This is very clearly demonstrated by e.g., case 8, where it was bronchospirometrically proved that the whole left lung did not take up any oxygen. Nevertheless the arterial oxygen saturation was normal.

However, when pathological circumstances have led to such a high pressure in the pulmonary arterial system that the barrier, formed by the pressure of the bronchial arterial blood, gives way, then venous blood flows through the diseased parts of the lung where no oxygen can be taken up, and a marked arterial oxygen undersaturation develops. It might even be possible for mixed venous blood to flow through the anastomoses towards the bronchial arteries and thus reach the left heart via the pulmonary veins. In this case the left-right shunt has changed into a right-left shunt. Case 11 is an example of this possibility. It is not impossible that this mechanism is active in the sudden marked arterial undersaturation, which is sometimes observed in cases of acute exacerbation in chronic pulmonary diseases.

Cases 9 and 10 are also interesting; the catheter, apart from being moved into the pulmonary artery of a shrunken tuberculous upper lobe, could also be brought into the pulmonary vein of this area through a foramen ovale and an atrioseptal defect. It was shown that the oxygen saturation of the blood in these pulmonary veins was only slightly lower than of the (oxygenated) blood of the pulmonary arteries. This proves that the circulation through the destroyed area was not obstructed, but that this area was perfused with arterial blood originating from the bronchial arteries, instead of with mixed venous blood from the right heart. This arterial blood gives off a little oxygen to the diseased tissue.

It is probable that the pulmonary haemorrhages which sometimes occur in bronchiectasis, tuberculosis, pulmonary cysts and other chronic pulmonary processes, originate in the dilated bronchial arterial system with its higher pressure than in the pulmonary arterial system and this is why they may be so profuse.

When considering pulmonary resection, it should be borne in mind that operation, apart from removal of the diseased parts, at the same time brings about a relief of the left heart, and in certain cases also of the right heart.

The phenomenon described is also of significance in other clinical observations, and it may explain seemingly contrasting experiences. Angiography in chronic pulmonary affections often reveals no filling of the pulmonary arterial system of the diseased part of the lung. In spite of this, it appears again and again at operation that these vessels bleed profusely. The fact that the pulmonary arteries are not filled during angiography should therefore not lead to the conclusion that they are poorly perfused with blood. The blood flowing through them is arterial blood originating from the bronchial arteries. In angiography the contrast medium cannot sufficiently (i.e., röntgenographically sufficiently) penetrate into the pulmonary artery, because it meets a counter current from the bronchial arteries. In this way the illusion of an empty pulmonary arterial system is formed, while in reality it is filled with blood from the bronchial arteries. This is the explanation why these pulmonary arteries may bleed profusely during operation.

SUMMARY

Cardiac catheterization revealed vascular left-right shunts, from the bronchial arterial system to the pulmonary arterial system in 11 patients with chronic pulmonary diseases. The significance of this is discussed. These shunts occur frequently in chronic pulmonary diseases.

RESUMEN

La cateterización cardiaca, reveló pasos vasculares de izquierda a derecha del sistema bronquial arterial, al sistema pulmonar arterial, en 11 enfermos con enfermedades cronicas pulmonares. La significación de esto se discute. Estos pasos ocurren con frecuencia enlas enfermedades crónicas pulmonares.

RESUME

Chez onze malades atteints d'affections pulmonaires chroniques, un cathétérisme ardiaque révéla un "shunt" vasculaire de gauche à droite, du système artériel bronchique au système artériel pulmonaire. Les auteurs discutent la signification de ces faits. Ces "shunts" se rencontrent fréquemment dans les affections pulmonaires chroniques.

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Extrapleural Pneumonolysis*

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Although the advances of chemotherapy and resection have greatly improved and extended the scope of therapy in pulmonary tuberculosis, it is apparent that they do not hold the answer for all treatment problems in the disease. This fact is attested by a not inconsiderable group of patients remaining in sanatoria for whom chemotherapy and usual conservative collapse measures have failed and vital capacity considerations, age or poor condition preclude thoracoplasty or resection. It is altogether fitting, therefore, that any procedure which widens the range of possible therapeutic moves and may be applied in such instances with some hope of benefit, receive continued consideration and investigation.

Extrapleural pneumonolysis, which may be described as the creation and maintenance of an extrapleural space, is one such measure that has interested thoracic surgeons since its introduction by Tuffier in 1891.[1] The interest has stemmed from its recognized merits of excellent selective collapse, minimal alteration in vital capacity,[2] minimal operative trauma and absence of deformity. However, the operation has never achieved wide popularity, due to the frequency of serious later complications. Initially such complications were attributed to the various materials used to maintain the extrapleural space. Later, with the utilization of paraffin and air for space maintenance, doubt was cast upon the complete validity of this idea, but no clear concept of fundamental factors involved in the operation was forthcoming. Recently, with the application of inert plombage materials and chemotherapy, the picture has cleared considerably and a better evaluation is possible. This report constitutes an evaluation of the operation based upon a comprehensive review of the literature, tissue implantation studies with various plastic materials and 17 instances of clinical trial using a new type prothesis.

History

Following the first recorded procedure consistent with the present day operation the generally accepted operative indication for extrapleural pneumonolysis evolved as inability to apply well established measures for collapse of an apical or sub-apical cavity. Most restricted its application as well to cavities whose (a) greatest diameter did not exceed 4 cm., (b) walls were thin (Pinner Type 2), (c) location was not close to the pleura,

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(d) bronchus was patent (non tension) and (e) surrounding disease was fibrotic.[3] As a result, the procedure was used mainly as a substitute for thoracoplasty when such was contraindicated because of age, poor condition, low vital capacity, bilateral or extrapulmonary disease. Pneumonolysis in conjunction with thoracoplasty (as a preparatory measure in poor condition patients and as a follow up procedure in residual cavitation) was done, also.

Earlier authors emphasized that the endothoracic fascia, a continuous sheet of tissue covering the inner aspect of the lung cage, diaphragm and mediastinum, is connected to the parietal pleura only by delicate fibrous strands with minute crossing vessels. The two can be separated quite easily by blunt dissection without significant bleeding. The plane between them is the "richtige schicht" of Schmidt[4] and the optimum site at which the extrapleural space is established. At the apex of the lung, the endothoracic fascia is enlarged by various extensions or so called ligaments. These fibro-ligamentous structures seemingly suspend the cupola of the parietal pleura by virtue of their attachments to the scalenus muscles, deep cervical fascia, first rib, subclavian vessels and neighboring structures. In a small percentage of attempted dissections there will be found extension of the pulmonary inflammatory process to the extrapleural space which makes the usually easy separation of pleura and fascia difficult, or at times impossible. In most instances this will be noted in the cupola region giving, in effect, a solid fibrous cord extending from the superior attachments of the fibro-ligamentous structures to the lung. Occasionally this process will be localized elsewhere or more or less generalized in the extrapleural space.

Four approaches to the thoracic cage were described, but the posterior was used most commonly and appeared best in most instances. An incision running midway between the spine and the scapula was made from the level of the second to sixth ribs and then curved laterally for a variable distance. This was carried through the muscle layers, the scapula retracted and the thoracic cage exposed. To open the thoracic cage the best technique was resection of part (10-12 cm.) of the third or fourth rib posteriorly, after carefully stripping its periosteum. The periosteal bed was incised longitudinally and the endothoracic fascia entered. Finger dissection was best to start the extrapleural space once the correct plane was reached. As it enlarged, gauze or a smooth blunt instrument could be used. In the event that cutting of adhesions was necessary, adequate visualization was imperative and a lighted retractor or head light used. The extent of dissection to be done was the only point about which a significant difference of opinion developed. While most did free the mediastinal pleura a few felt it should be left intact. Otherwise, a complete dissection was done inferiorly to well below the lesion. The insertion of the plombe followed, the technique varying with the material used. Closure was done tightly in layers with fine silk.

Extrapleural fibrosis was considered to be an important warning sign. Any attempt to complete a space dissection made difficult by fibrosis fre-

quently resulted in pleural tears with extension into the lung or a cavity. Entering a cavity demanded that the procedure be discontinued. This was true, also, of entering the lung parenchyma at any point as space infection was certain. Entering an adhesive pleuritis demanded serious thought before continuing because of the possible presence of tubercle bacilli in adhesions. When the apical cord was severed by sharp dissection, injury to the subclavian vessels or other important structures in the vicinity occurred occasionally.

In doing the first procedure Tuffier used no filling material in the space.[2] For a short period this technique was followed but it became apparent rapidly that obliteration of the space by the natural processes of repair with re-expansion of the collapsed lung was an almost unfailing sequel. Quite naturally, therefore, the idea of using some material to maintain the space arose. In 1901, Sarfert[3] used a gauze filling preliminary to cavity drainage. This was the first report of a plombage medium. Subsequently, a number of other materials were tried as temporary expedients of which air (extrapleural pneumothorax) was most notable. Mayer in 1913[5] was the first to use air and shortly thereafter many reports about it ensued from Europe. In 1936, Graf[6] suggested standardization of technique and selection of cases in extrapleural pneumothorax. He, along with Schmidt, perfected the technique for creation of the space as well. At first there was considerable enthusiasm, but it dimmed quickly because it was noted that the space was hard to maintain, infection was frequent, re-expansion (after operation) with initial air injection often failed and the frequency of the need for subsequent thoracoplasty or oleothorax. Dolley, Jones and Skillen in 1940[7] reviewed over 2,000 cases. Their collected results showed approximately 63 per cent success in converting sputa, but with a 12 per cent mortality and a high incidence of necessary conversion to oleothorax which became permanent or required thoracoplasty. Eventually, it was seen that temporary plombage by any means would not be definitive treatment and permanent filling of the space would be required ultimately.[8]

Permanent plombage was attempted first by Tuffier in 1910[9] using fat from the patient. A number of others tried this as well. However, as its supply in most patients with tuberculosis was limited and gradual degeneration and absorption of the fat with loss of collapse was noted frequently, it was discarded. Shivers in 1917[10] suggested and used muscle for the first time as a filling material. To this two serious drawbacks became manifest. The added surgery necessary to mobilize the muscle removed the operation from the tolerance range of many patients and muscle degeneration with loss of substance (which took place in spite of pedicle blood supply) allowed loss of collapse. It is quite understandable that paraffin, subsequent to its introduction by Baer in 1913,[11] became the outstanding medium for plombage. With the widespread application that ensued (especially in Europe), however, it was established that unrestricted use was associated with a high incidence of complications. Accordingly, in an effort to improve the situation, case selection of smaller

lesions and limitation of the amount of paraffin used were instituted. The effectiveness of these two measures was demonstrated by McIndoe and others.[12] However, because no clear cut distinction between the material and lesion relative to their importance in complications was made, paraffin bore the brunt of blame. The usual assumption was that the material, because of its foreign body reaction and weight, eroded into the compressed cavity or area of disease.

The more recent revival of interest in extrapleural pneumonolysis followed the introduction of lucite balls by Wilson and Baker[13] in 1946. Though a fair period has elapsed now for evaluation of the spheres, confusion remains as to their merit. It is difficult to reconcile the conclusions of those who pioneered their use—that lucite plombage of the extrapleural space was not to be recommended, even with ideal indications[14] —and the relative satisfactory results of later workers. (i.e. Grow et al[15] and Brantigan and Rigdon.[16]) It is logical, however, to assume that further time will increase the complications experienced by the latter. Of considerable significance is the fact that for the first time an essentially inert material was used for plombage and, because of the hollow nature of the balls, the total prosthesis had insignificant weight as well. Thus, the two main objections to paraffin were answered and yet similar complications were noted by those with the longest experience. More recently several other "inert" materials were tried. O'Neil, et al used fiberglass wool and fabric.[17] In 1949, Condon and Harper [18] reported the use of polyethylene film. Finally polyvinyl formal sponge[19] was applied. With any of these, however, significant follow up results remain to be presented.

Regardless of the material used for plombage, later complications seen were of the same type with few exceptions. Of these, the most significant was the development of a broncho-pleural fistula and its sequel, tuberculous space infection. Non-specific space infection occurred early in the post operative course, and was followed frequently by extrusion of the pack through the wound. Expectoration of paraffin through the bronchus was noted, and it happened up to many years following plombage. Space infection was not necessarily a co-incidental complication with this. After a fair period had elapsed since implant, fibrous tissue walling off of the mass occurred with its separation into small isolated lumps, (paraffinoma). Excess fluid about the pack was evident frequently and was felt to predispose to space infection. Compression of hollow viscera and large vessels was seen at times with paraffin. Wandering lucite balls occasioned similar effects. The reported incidence of these complications varied greatly from one author to another depending upon the follow up interval, operative indications, etc. Accordingly, no good average figures are ascertainable. It is fair to conclude, however, that generally the incidence of serious complications was high on a long term basis.

New Prosthesis

In 1949, after a review of the foregoing considerations, we felt that for successful plombage of the extrapleural space in tuberculosis three

things were of fundamental importance: viz. (1) the nature of the lesion to be collapsed, (1) the technique of the extrapleural dissection and (3) the type of plomage material. While the technical features of the space creation were fairly well established, however, the status of the others was not. It seemed likely that clarification as to the nature of the lesion which could be attacked safely by the procedure would have to await the development of a prosthesis that could not be held as a casual factor in complications. The essential demands to be met by this plombe appeared to be, therefore, that it (1) effectively maintain the space, (2) cause no reaction in tissues by its presence and (3) exert no pressure effects upon its supporting tissues.

Following animal implantation studies with a number of plastic materials,* we devised a prosthesis consisting of a rectangular bag (46 x 26 cm.) made from polyethylene film (.005-.010 cm. thickness) and containing a polyvinyl formal sponge filler. The technique adopted for its application to the space was as follows: after creation of the space is completed, the bag (which has been pre-sealed on three sides and sterilized in aqueous Zephiran) is placed therein with its open end outward. A hand is inserted and the bag expanded and moulded to conform to the space (folds are of no consequence). The sponge, which has been sterilized in aqueous Zephiran, is cut to conform roughly to the space and inserted. Enough sponge is used to completely fill the bag, but not to exert pressure on the collapsed lung against the mediastinum. Multiple small pieces are added if necessary. Next, all anesthesia is discontinued and the patients' airway flushed out. The wound is covered with wet towels allowing the open end of the bag to protrude for closure. The protruding edges are approximated between two straight edged metal bars and heat sealed. The sealing can be done with a kitchen match held in a hemostat and passed slightly above and along the edges slowly, or as later discovered with a sterilizable miniature alcohol blow torch giving a small, pointed and well controlled flame. Sealing in this manner is possible due to the relatively low melting point of polyethylene (110-120° C) and its thermoplastic behavior of resetting upon cooling. With momentary melting of the edges, fusion occurs. The metal bars control the direction of (and prevent melting of the plastic away from) the line of seal. This bond is of the same or greater strength than the original material. The protruding sealed end is folded and tucked within the space to lie along the rib cage side. Practice is necessary before flame sealing should be attempted in the operating room, but the technique for an excellent seal can be mastered after a few trials. From a practical standpoint this method is cumbersome, but it is satisfactory on a research basis. Recently, we have found a tightly tied 00 or larger silk tie about the protruding bag end gives an adequate seal for a temporary prosthesis. With utilization of the foregoing materials and technique, it was felt that the essential criteria for the desired prosthesis would be satisfied. Accordingly, clinical trial was contemplated.

*To be published.

Case Reports

Over a two year period (1950-51) 17 patients from three hospitals,* comprising approximately 250 beds for active tuberculosis, were done. While most did conform to usual operative indications, in several instances this was only because thoracoplasty and/or resection were refused. In others, usual limitations as to the nature of the lesion to be collapsed were exceeded to effect trial of the prosthesis over a wide range of lesions in respect to cavity size and pleural proximity. All had positive sputa preoperatively and were given PAS, streptomycin and penicillin before and after. In all 18 procedures were done, one patient having had a "repacking." In three instances no polyethylene bag was used around the sponge, but otherwise, all were done in the manner described. Postoperatively sputa smears and cultures were done at semimonthly intervals. Gastric washings were done on all negatives. Post operative observation intervals reported vary from 16-26 months.**

Case 1: R. H., a 51 year old white man. Right plombage was done in November 1950. Cavity diameter was 5.5 cm. and pleural distance 4 cm. Cavity closure was effected and all sputa have been negative since operation. No complications have been noted. The patient was discharged as apparently arrested for out patient follow up. Comment: emphysema and pneumoconiosis with low vital capacity were present but no subjective vital capacity change was noted post operatively.

Case 2: J. G., a 41 year old white man. Right plombage was done in December 1950. Cavity diameter was 3.5 cm. and pleural distance 4 cm. No bag was used around the sponge. Cavity closure was effected but not sputa conversion, due to opposite lung cavitation. At operation a small pleural tear into an adhesive pleuritis was made and repaired. Excessive fluid was noted early in the post operative course, but gradual absorption followed. At the present time a small amount of fluid remains. The patient is still in the sanatorium and gradually improving. Comment: massive hemoptysis present pre-operatively (the main indication for the procedure in this instance) was effectively controlled by plombage. Aspirations of the excess fluid showed no growth to culture. It is considered that failure to use a bag, and the hygroscopic nature of the sponge explain the presence and persistence of fluid.

Case 3: P. K., a 35 year old white man. (Figure 1.) Left plombage was done in December 1950. Cavity diameter was 2.2 cm. and pleural distance, 2 cm. Cavity closure was effected (Figure 2.) and sputa conversion noted for the first four months together with some excess fluid. With re-absorption of this fluid, however, sputa returned to a positive status and remained so until August 1952, since which time all have been negative. The patient remains in the sanatorium.

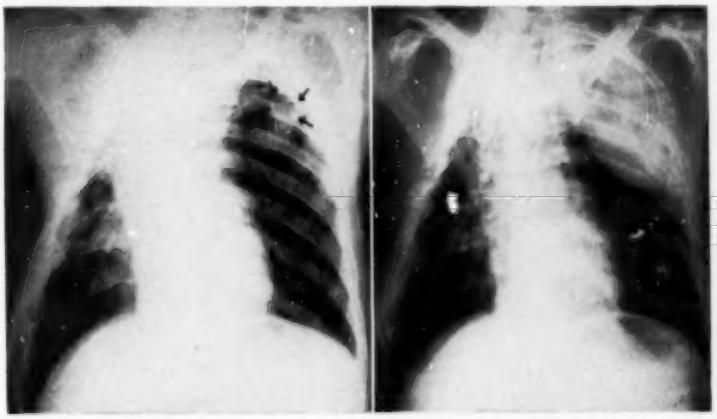

FIGURE 1 FIGURE 2

Figure 1: Preoperative x-ray of case 3.—*Figure 2:* One month postoperative x-ray of case 3.

*The Rocky Glen Sanatorium for Tuberculosis, McConnelsville, Ohio.
The Richland County Tuberculosis Sanatorium, Mansfield, Ohio.
The White Cross Hospital, Columbus, Ohio.
**as of January 1953.

Case 4: N. H., a 31 year old white man. Right plombage was done in December 1950. Cavity diameter was 2 cm. and pleural distance 2 cm. Cavity closure was effected, but not sputa conversion, due to an additional right middle lobe cavity. No complications were noted. Later (July 1952) spontaneous closure of the right middle lobe lesion effected a negative sputa status. The patient remains in the sanatorium. Comment: no subjective vital capacity change has been apparent in spite of a complete opposite thoracoplasty.

Case 5: M. K., a 26 year old white woman. Left plombage was done in January 1951. Cavity diameter was 6.5 cm. and pleural distance, 1 cm. Cavity closure was not effected as dense adherence of the apex precluded complete disection. The cavity was narrowed to a slit, however, and gradually closure did ensue. No operative complications were present but excessive fluid was noted in the early post operative course. Following this sputa became negative. At first the fluid was sterile, but following numerous aspirations its spontaneous escape from a puncture site occurred and non-specific empyema resulted. The patient expired in May 1952, in the sanatorium presumably of heart failure. No post mortem examination was done. Comment: this patient was a drug addict and in extremely poor condition. It seems likely that the multiple aspirations were responsible for the non-specific empyema and cutaneous fistula. The large cavity diameter and a small pleural distance are notable. It is conceivable that a broncho-pleural fistula was prevented by leaving the apical adherence intact at operation.

Case 6: H. B., a 36 year old white man. Initial left plombage was done in January, 1951 for a 2.5 cm. diameter cavity, 1.5 cm. from the pleura. Cavity closure was not effected nor was sputa conversion. No complications ensued. Repacking was done in September 1951. This time the sponge alone was used. During the procedure a biopsy of the wall of the space was taken. Cavity closure was not effected. Sputa did not convert. Excessive post operative fluid occurred. Recently a broncho-pleural fistula, as evidenced by a pneumothorax about the pack has developed. The patient remains in the sanatorium. Comment: resection and thoracoplasty are planned. The fluid accumulation occurring when the sponge alone was used and its absence with the bag is notable. The space wall biopsy showed "collagenous fibrosis replacing granulation tissue. No evidence of infection or foreign body reaction."

Case 7: T. P., a 47 year old white man. Right plombage was done in February 1951. Cavity diameter was 2 cm. and pleural distance, 2 cm. Cavity closure was effected as well as sputum conversion. No operative or post operative complications were noted. The patient has been discharged from the sanatorium as apparently arrested for outpatient follow up.

Case 8: O. D., a 29 year old white woman. Left plombage was done in April 1951. Cavity diameter was 2 cm. and pleural distance, 4 cm. Cavity closure and sputum conversion were effected. No operative or post operative complications were noted. The patient was discharged from the sanatorium as apparently arrested to be followed as an out patient. Comment: the lesion in this case was hilar in location and with little, if any, surrounding disease. A small pack was inserted laterally, pushing the underlying lung and cavity toward the hilus.

Case 9: G. H., a 56 year old white man. Right plombage was done in May 1951. Cavity diameter was 3 cm. and pleural distance, 1.5 cm. Cavity closure was affected and sputa were negative for the first six months postoperatively. Then recurrent positive sputa were noted along with questionable ipso-lateral lung spread. This since has healed and sputa returned to a consistently negative status. No other operative or postoperative complications were noted. The patient has been discharged for outpatient follow-up as apparently arrested. Comment: this is the only possible instance of disease spread noted.

Case 10: J. G., a 36 year old white man. Left plombage was done in May 1951. Cavity diameter was 4 cm. and pleural distance 2.5 cm. Cavity closure was effected as well as sputum conversion. No operative complications were evident and the early postoperative course was uneventful. The patient left the sanatorium. In December 1951, the patient noted the onset of low grade fever despite a negative gastric smear. In March 1952, the patient developed a productive cough and sputa were positive for acid-fast bacilli. In May 1952, he entered the Ohio Tuberculosis Hospital at which time the pack was removed. Three broncho-pleural fistulae were noted. Thoracoplasty was done followed by a left upper lobectomy and decortication of the lower lobe. At the present time the patient is making a satisfactory recovery and sputa have been negative since thoracoplasty. Comment: three bag defects were found each measuring one millimeter. The parietal pleural layer was "apparently destroyed" according to the operator.

Case 11: L. H., a 59 year old white woman. Right plombage was done in January 1951 for a 2 cm. diameter cavity located 2 cm. from the pleura. Cavity closure was effected, but sputum conversion was not. At the time of operation a pleural tear with pneumothorax required aspiration and repair. No postoperative complications

have been noted. At the present time the patient remains in the sanatorium. Comment: it is felt that the occasional positive sputa found in this patient is explained by recurrent activity underneath an opposite 7 rib thoracoplasty. No subjective vital capacity change has been evident.

Case 12: J. L., a 32 year old colored man. Left plombage was done in June 1951 for a small persistent cavity in a moderate sized area of disease located in the apex toward the mediastinum. Disease space distance was 3 cm. Adequate collapse was judged to be present and sputum conversion occurred. No operative complications were present, but early in the postoperative course, excessive fluid accumulation was noted with slight mediastinal shift. This absorbed completely, however, and at the present time, appearance of the pack is excellent to x-ray. The patient has been discharged from the sanatorium as apparently arrested for outpatient follow-up. Comment: the excessive fluid accumulation in this instance may have been due to an initial bag defect. All aspirations were negative for acid-fast bacilli and the response to aspiration complete. This was the minimal lesion of the series.

Case 13: R. H., a 38 year old white man. Right plombage was done in April 1951. Cavity diameter was 4 cm. and pleural distance, 3.5 cm. Cavity closure was effected, but sputum conversion was not. There was no operative or other complication. The patient remains in the sanatorium. Comment: failure to convert sputa was based on contra-lateral upper and ipso-lateral lower cavitation, both present preoperatively.

Case 14: F. S., a 55 year old white man. Right plombage was done in September 1951 for an 8.5 cm. cavity located ½ cm. from the pleura. No bag was used. Cavity closure was effected, but sputa failed to convert. No operative complication was noted, but early moderate excess fluid followed and at approximately three months a broncho-pleural fistula resulted. Shortly thereafter, the pack was removed and a first stage thoracoplasty done. The patient expired the fourth postoperative day following this. Comment: failure to convert sputa was based on generalized parenchymal disease. The patient's condition was extremely poor pre-operatively. Improvement was noted with cavity closure but ended with fistula formation. The extreme cavity diameter and minimal pleura distance are notable. Early fluid excess was due, probably, to use of the sponge alone.

Case 15: V. H., a 65 year old white woman. Right plombage was done in August 1951. A 3 cm. diameter cavity was located 2 cm. from the pleura. Cavity closure and sputum conversion were effected. No operative or postoperative complications were noted. The patient was discharged from the sanatorium as apparently arrested to be followed as an outpatient.

Case 16: P. O., a middle aged white man. Right plombage was done in September 1951. A 1.5 cm. diameter cavity was located 1.5 cm. from the pleura. Cavity closure and sputum conversion were effected. No operative complications were noted but excessive fluid was noted in the postoperative course. Some excess fluid still remains. The patient remains in the sanatorium.

Case 17: L. P., a middle aged white man. Right plombage was done in April 1951. A 2 cm. diameter cavity was located 3 cm. from the pleura. Sputum conversion and cavity closure was effected. There have been no complications. The patient has been discharged as apparently arrested for outpatient follow-up.

Results

As shown in Figure 3, of the 17 operated apparent cavity closure was achieved immediately in 14 (82 per cent) and eventually in two others (12 per cent). Sputa conversion was considered to be possible in thirteen instances. It was achieved immediately in eight (48 per cent) and subsequently in four more (18 per cent). Complications to date (Figure 4) have been noted in ten patients (59 per cent) but of these only four (24 per cent) were of serious import. A mortality ensued in two patients (12 per cent) none due to the procedure per se but related to complications resulting therefrom.

Complications of a minor nature found were as follows: operative pleural tears in two (12 per cent) excessive fluid accumulations in seven (41 per cent), and slight disease spread in one (6 per cent). Those of major significance were: broncho-pleural fistula in three (18 per cent) and non specific space infection in one (6 per cent). The relationship of cavity

size and pleural distance to major complications is diagramatically illustrated in Figure 5.

Conclusions

On the basis of our review of the literature, study, clinical trial and results to date with extrapleural pneumonolysis, we have arrived at the following conclusions:

In creating the extrapleural space the parietal pleura is separated from its blood supply, the intercostal vessels. In the event that underlying lung has sufficient blood supply, this of no apparent significance. However, if the lung lying between the space and cavity is dependent upon

RESULTS	
Cavity Closure	94%
Sputa Conversion	66%
Serious Complications	24%
Mortality	12%

FIGURE 3

COMPLICATIONS	
Minor:	
Operative pleural tears	12%
Excess fluid	41%
Disease spread	6%
Major:	
Bronchopleural fistula	18%
Nonspecific Empyema	6%

FIGURE 4

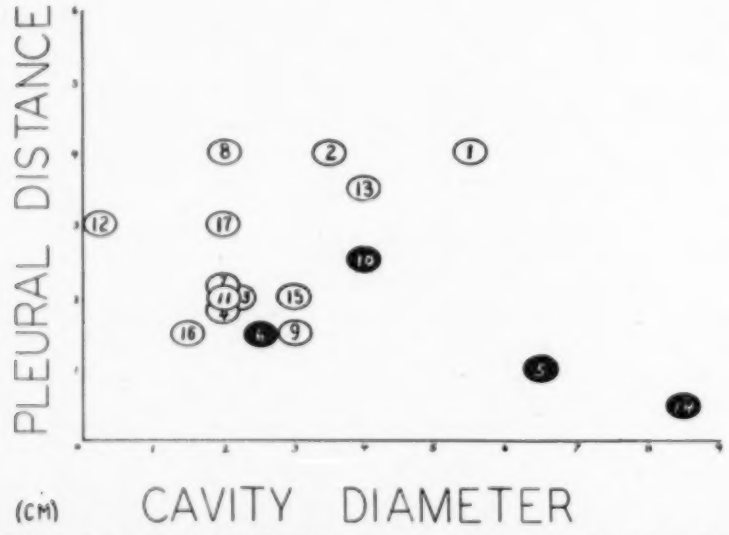

FIGURE 5: Cases plotted graphically by number relative to cavity size and pleural distance. Those with serious complications (dark ovals), in contrast to those without (clear ovals), tend to locate in the right lower aspect where cavity is larger and pleural distance smaller.

intercostal vessel connections (via pleural adhesions) for viability, necrosis will ensue.* As a result, fistula formation and space infection will be inevitable in such instances with any plombage material. It appears, therefore, that the nature of the tuberculous lesion is the greatest factor related to serious complications. This dictates that the procedures' application as a permanent method of collapse can be considered only in lesions which suggest that the central blood supply to the lung periphery in question is intact. In turn, this suggests small cavities well removed from the contemplated space and with little surrounding disease. In less favorable circumstances it can be considered as a temporary method of collapse only. Temporary use requires, of course, that a definitive follow up measure be possible. As in most instances low pulmonary function is an essential feature, the only allowable move is to do a modified thoracoplasty, tailored to fit the existing collapse. This will safely maintain the space and will not further affect the vital capacity appreciably. It may be done bilaterally in some cases, as well. Rarely, such as in instances of adequate ventilation for which temporary collapse is used simply to improve a patient's poor condition, a staged thoracoplasty, or even resection, may follow. If no follow up measure is possible and the lesion in question is suitable for temporary plombage only, the idea of extrapleural pneumonolysis should be discarded. Extraperiosteal plombage is a possible alternative in this circumstance. While it does not give as ideal selective collapse, little operative trauma and minimal vital capacity change, it affords considerably better protection against fistula development due to the fact that it does not deprive the lung periphery of intercostal blood supply.

At the present time there is no accurate method to determine the nutritional status of the underlying lung. This fact allows us to recommend only one operative indication for extrapleural pneumonolysis: instances in which temporary collapse for apical or sub-apical cavitation is needed to prepare patients for a later modified thoracoplasty, staged thoracoplasty or resection that can not be done primarily. The time interval between plombage and definitive treatment that is allowable is indefinite, but logically it should vary directly with favorable aspects of the lesion and always be as short as possible. It seems probable that fairly exact criteria as to cavity size and pleural distance can be established which will give a satisfactory approximation of the peripheral lung status. Hence we feel that rarely with certain lesions the procedure may be used as a permanent method of collapse, such as in advanced age or low vital capacity patients, to render sputa conversion and effect partial (i.e.: social) rehabilitation in otherwise hopeless circumstances. While some risk is involved we feel that serious complications can be minimized to an acceptable level by adherence to the concept of use we have proposed. However, until our follow up period is sufficient to allow a longer range estimate of the probability of serious later complications as compared with lesion characteristics, we make no specific recommendation in this regard.

*Grow et al have reported a similar conclusion. (Dis. chest; 22:5, p. 491, Nov. 1952)

In doing the operation, the posterior approach is best. Resection of at least 10 cm. of the third or fourth rib posteriorly is the preferable method to open the thoracic cage. Finger dissection of the space is most discernable and safe. The extent of dissection should assure that the entire thoracic parietal pleura including the apex has been freed to well below the cavity inferiorly, but the mediastinal attachment should be left intact. Plombage by whatever method should not be done to effect pressure on the collapsed lung, but simply to fill the created space. In the event that extrapleural fibrosis is encountered which make the dissection difficult or requires significant sharp dissection, it is probable that the procedure should be terminated. Certainly this is true if permanent plombage is contemplated, because not only are pleural tears with extension into the lung or a cavity likely but it is probable that the dissection will effect an inadequate blood supply to the underlying lung. Entering a cavity or the lung demands closure of the communication and termination of the operation. Entering the free pleural space requires only aspiration and closure of the pleural defect. Injury to the intercostal or sub-clavian vessels and important structures about the apex is not likely unless sharp dissection is used.

While the type of prosthesis is to be considered less important than the nature of the lung lesion, the more closely it approaches the ideal of (a) permanently maintaining the space, (b) producing no reaction in surrounding tissues and (c) exerting no pressure effects on supporting tissues, the more likely will be a satisfactory result. Any medium which can satisfy these requirements appears acceptable. This would include air as advocated by Cutler.[20] In our opinion, however, the necessity for constant refills and space size fluctuations make extrapleural pneumothorax less ideal than a stable medium. A prosthesis consisting of a sealed polyethylene film bag containing a polyvinyl formal sponge filler as described appears satisfactory. Use of the bag is indicated, in our opinion, by a slight foreign body reaction which accompanies implantation of the sponge alone, the hygroscopic nature of the sponge, ease of prosthesis removal when necessary and effecting a single unit prosthesis with multiple sponge pieces (often needed for adequate space filling). Certainly a bag should be used in temporary plombage and satisfactory sealing for this can be accomplished by a silk ligature. If permanent plombage is contemplated, heat sealing closure is advisable. While the bags' integrity is not maintained indefinitely, probably,[21] it is until an adequate space wall has formed and a defect is of little significance. Flame sealing (as described) is satisfactory from research standpoint, but not ideal from an ordinary operating one. A more practical solution is being sought.

Cavity closure can be obtained in a high percentage of instances with extrapleural pneumonolysis and sputa conversion will be gratifying. Vital capacity effect will be minimal. Excessive fluid accumulation will be noted frequently (41 per cent), but with antibiotic coverage is not to be greatly feared. With restricted use of the procedure to the single operation recommended (temporary, plomage only), serious complications will be nil

or infrequent in our opinion. This is evidenced in this series by a delay in the onset of fistula and space infection of three months with an exceedingly unfavorable lesion (Case 14), and up to one year in better (but still not good) circumstances (Case 6). If permanent plombage is contemplated, the fact that significant complications will vary directly with cavity size and inversely with pleural distance should be kept in mind and its use restricted to relatively ideal lesions in this regard.

SUMMARY

The historical record of Extrapleural Pneumonolysis is reviewed. A new prosthesis, that meets the essential plombage demands of the operation and which in our opinion can not be held as a casual factor in the development of serious complications, is described. Seventeen case reports with 16-26 month interval results are presented. It is concluded that the development of a broncho-extrapleural fistula, which is the significant serious complications seen, is primarily dependent upon the nature of the tuberculous lesion in question, by virtue of its effect on the nutritional status of the lung periphery underlying the prosthesis. It is recommended, therefore, that the procedure be used only as a method of temporary lung collapse in upper lobe cavitation, to prepare patients for a later modified thoracoplasty, staged thoracoplasty or resection that can not be done primarily. It is suggested that permanent plombage may be indicated in otherwise hopeless circumstances, such as those occasioned by advanced age or low vital capacity, for collapse of small cavities well removed from the contemplated space and with little surrounding disease. However, as exact limitations for cavity size and pleural distance can not be proposed at present, due to an insufficient follow up interval for the cases studied, no specific recommendation is made in this regard.

RESUMEN

Se hace una revisión de la historia de la neumonolisis extrapleural. Se describe un nuevo material de prótesis que según nuestra opinión, no peude ser agente causal de serias complicaciones. Se refieren diecisiete casos con resultados de 16 a 26 meses de observación.

El desarrollo de la fístula bronco-extrapleural que la complicación más importante observada depende en primer lugar, de la lesión tuberculosa que se trate en virtud de efecto sobre la nutrición de la periferia pulmonar debajo del material protésico.

Se recomienda por tanto, que el método se use para colapso temporal en las cavidades de lóbulo superior, para preparar los enfermos para una toracoplastía, toracoplastía en varios tiempos o para hacer después una resección que no pudo hacerse primariamente.

Se sugiere que el plombaje permanente está indicado en circunstancias en las que de otra manera nada se podría hacer, tales como la edad avanzada o reducida capacidad vital, o para el colapso de pequeñas cavidades alejadas del espacio que se ha de crear y con escaso compromiso del tejido pulmonar circundante.

Sin embargo, como no pueden proponerse por ahora precisas limitaciones para el tamaño de la caverna y para la distancia a la pleura, debido al insuficiente período de seguimiento de los casos estudiados, no se hace una recomendación determinada a este respecto.

RESUME

Les auteurs rappellent l'historique du pneumothorax extrapleural. Ils décrivent un nouveau procédé de prothèse qui répond aux nécessités essentielles du plombage dans cette opération et qui, à leur avis, ne peut être considéré comme un facteur éventuel de complications graves.

Ils rapportent 17 observations dont les résultats remontent à 16 à 26 mois. Ils en concluent que l'apparition d' une fistule broncho-extrapleurale qui est la plus notable des complications importantes qu'ils ont vues dépend de la nature des lésions tuberculeuses en cause. Celles-ci en effet exercent leur action sur la qualité du tissu pulmonaire qui avoisine les éléments de la substance de prothèse. C'est pourquoi les auteurs demandent que l'utilisation de ce procédé soit réservée à un collapsus temporaire des cavernes du lobe supérieur. Ainsi le malade pourra être préparé pour une thoracoplastie ultérieure ou pour une exérèse qui n'auraient pas pu être réalisées d'emblée.

Ils proposent que le plombage permanent soit réservé à certaines circonstances désespérées dues soit au grand âge du malade ou à sa capacité fonctionnelle réduite et qu'enfin ce collapsus ne s'applique qu'aux petites cavités, nettement à distance de la zone de l'extra-pleural et sans grande altération parenchymateuse alentour.

Toutefois, les auteurs ne peuvent proposer de normes précises concernant les dimensions des cavernes sur lesquelles l'opération peut être appliquée et la distance à laquelle elle doit être située par rapport à la plèvre, car ils n'ont pas eu jusqu'à présent un assez long recul pour juger de l'evolution des cas étudiés.

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Pulmonary Echinococcus*

SURGICAL TREATMENT IN 124 HYDATID CYSTS

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Man is the intermediary host of an intestinal parasite of the dog: Tenia echinococcus. Infection is produced by its eggs which are usually absorbed in contaminated food, the liberation of a hexagonal embryo takes place reaching the systemic circulation thorough the portal vein and being distributed to the various organs. The two parenchymas most frequently affected are those of the liver and lung. The embryo grows within the organ affected and turns into a larva which takes on the morphology of a uni- or multi-locular cyst with crystal clear liquid contents.

In the lung the cyst is nearly always unilocular with liquid contents and the parasitic membrane surrounded by an adventitial layer. This is a fibro-connective lamina pertaining to the lung which has thus reacted to the growth of the cyst. This description applies to the pure and uncomplicated *hyaline hydatid cyst*. When the cyst has reached a large size it generally opens into a bronchus and a hydatid vomica or hydatidoptysis occurs. Rupture of the cyst in the pleura is less frequent (hydatidopleura). At any rate in either case it ceases to be *hyaline* or clean and becomes complicated, infected or suppurating.

The main symptoms are then those of a bronchopulmonary suppurative condition. In complicated cysts with a prolonged clinical course other pulmonary lesions such as: bronchiectasis, pleuritis, etc. appear.

Surgical treatment varies according to the number, size and clinical course of the cysts, and according to the presence of complications. The parasite and host must both be taken into account, in other words, the removal of the larvae or cysts and treatment of associated pulmonary lesions, if any, with prophylaxis of the residual pulmonary cavities.

We advise the use of general anaesthesia with hyperpressure and a large opening obtained by posterolateral thoracotomy allowing for complete exploration and a proper approach in each case. As a rule, we prefer an economical procedure with minimum resection, the disease being generally benign.

Surgical tacties vary. The techniques most commonly resorted to are:

a)—*Posadas' Operation* and or its variation: pneumocystostomy extraction of the whole cystic membrane (as in parturition) or by rapid aspiration; with or without suture of the visible bronchial orifices which communicate with the adventitial cavity; with or without resection of the surplus adventitial membrane and closure of the pneumocystostomy.

b)—*Marsupialization*. Pneumocystostomy. Aspiration of the cystic membrane and contents; with or without suture of the bronchi communi-

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cating with the adventitial cavity, with or without resection of surplus adventitial membrane and direct drainage of the pneumocystostomy.

In the first case (direct drainage) the opening of the pneumocystotstomy is sutured to the cutaneous planes of the thoracotomy. In distant drainage a Pezzer catheter is used without fixing the lung, the catheter being attached to the pneumocystostomy and passing out through the thoracotomy or through a counter opening.

c)—*Resection of Adventitial Membrane.* This is known as the Velarde Perez Fontana procedure. The resection may be total or subtotal, and of course, no residual cavity is left. It really amounts to a minimum, atypical partial pulmonary resection as the adventitial membrane belongs to the lung and is a fibrous reaction opposed by the organ to the cyst's growth.

d)—*Atypical Pulmonary Resection* (wedge shaped) is an economical ablation indicated in certain cases.

e)—*Segmentary Resection* (typical or atypical) *lobectomy*, bilobectomy or *pneumonectomy*, too well known to be described here.

The selection of procedure varies according to the number and size of the cysts, existence of complications (suppuration, hemorrhage) and associated bronchopulmonary lesions.

For small or medium sized hyaline (noncomplicated) and single cysts we prefer the Posadas procedure. If the cyst is large or complicated (suppuration, etc.) we prefer marsupialization. If there are several cysts, or if they are large, complicated or associated with other lesions (bronchiectasis, tuberculosis, pneumonitis, etc.) we advise the most economical pulmonary resection. In the case of children and young adults we are strictly conservative.

In hydatidopleura usually secondary to a pulmonary cyst, we perform a large thoracotomy, for treatment of a ruptured pulmonary cyst and in the case of an inexpansible lung pleuropulmonary decortication is indicated.

In our Institute of Thoracic Surgery we have treated surgically 124 cysts in 104 patients in 117 operations.

TABLE I

Patients	104
Cysts	124
Operations	117
Pulmonary Resections:	59
Pneumonectomies	3
Lobectomies	25
Atypica 1 Resections	31
Other Procedures:	58

TABLE II

	Total	Hyaline	Nonhyaline	Operations	Deaths
Pulmonary Resection	66	35	31	59	2
Marsupialization	39	16	23	39	—
Posadas' Operation	15	8	7	15	—
Drainage	4	—	4	4	1
	124	59	65	117	3 (2.6%)

These operations comprise two large groups: pulmonary resections (pneumectomies, lobectomis, partial resections, segmentary or Velarde Perez Fontana procedure) and other procedures (marsupialization with or without bronchial suture, closing of the adventitial layer after the manner of Posadas, etc.

Pulmonary resection was performed on an equal number of hyaline and non-hyaline cysts. Two deaths occurred for 59 resections.

Marsupialization was performed predominantly in cases of non-hyaline cysts; no death was recorded among the 39 resections performed by this method.

Posadas's operation was performed on an equal number of hyaline and nonhyaline cysts; no death was recorded in the 15 operations.

Thoracic drainage was carried out in four cases: two relapses and two interpleural ruptures of pulmonary cysts.

As a result, out of 117 interventions for treatment of 124 cysts, a primary mortality of three cases (2.6 per cent) was recorded.

For partial resections various surgical procedures were employed each of which should be considered separately.

Segmentary pulmonary resection whether wedge shaped or atypical was performed in 20 cases. On 14 cysts an almost complete resection of the adventitia was carried out, a surgical operation known in the River Plate countries as Velarde Perez Fontana's procedure.

In 19 of the 34 cases of cysts treated by partial resection, suture of one or several bronchi opening into the adventitia was added.

The open edges resulting from the partial pulmonary resection were brought together by means of interrupted stitches of absorbable material in 23 cysts.

In the remaining 11 cases the adventitial or sanguineous surface limited by these edges was either marsupialized or left in the interior of the pleural cavity.

Surgical treatment in children from four to 15 years of age offered certain special characteristics. Our experience extends to 16 patients who underwent 22 operations for treatment of 23 cysts.

TABLE III

Patients			16	
Interventions			22	
Cysts			23	
			Hyaline	Non-Hyaline
With Pulmonary Resection: 7	Lobectomy	2	—	2
Without Pulmonary Resection: 16	Partial Resection	5	5	—
	Marsupialization	7	4	3
	Posadas's Operation	8	6	2
	Pulmonary Decortication Marsupialization			
23			15	8

Pulmonary resection was performed in seven cysts, lobectomy being practiced in two non-hyaline cysts and partial resection in 5 hyaline cysts.

Lobectomy, technically rather easy in children, is recommended for cases of non-hyaline cysts, infected and covering nearly the entire lobe. In two other cases we prefer partial resection or other procedures (Posadas', marsupialization, etc.,) considering the easy anatomical and functional recovery of children's lungs and hence the undesirability of serious surgical mutilation.

Surgical procedures without pulmonary resection were performed in 16 cysts. In seven cases, marsupialization was carried out in eight, Posadas's operation and in one case of ruptured cyst into the pleural cavity, marsupialization of the adventitia and pulmonary decortication were performed.

Evacuation of the parasite in very large cysts occupying nearly the entire lobe was followed by re-expansion of a considerable area of lung.

The adventitial cavity was seen to disappear with surprising rapidity.

An equal number of hyaline (59) and non-hyaline (65) are comprised in the group of 124 cysts given various types of surgical treatment.

Pulmonary resection is the treatment of choice in cases of hyline cysts, then marsupialization, direct or indirect, and last Posadas's operation. Pulmonary resection was performed partially or in segments, lobectomy or pneumonectomy being reserved for cases of multiple cysts, or of cysts occupying an entire lobe or lung. Marsupialization was preferred to closing of the adventitial cavity (Posadas's operation) for large cysts, particularly those located in the inferior-lobes.

No death was registered among the 59 cases of hyaline cysts.

In the non-hyaline series differentiation should be made between cases of intrabronchial rupture and those of intrapleural communication. The latter present extremely serious complications which require urgent pleural drainage. In the last case, a pulmonary decortication was performed and indirect marsupialization of the adventitial cavity with excellent results. The oldest patient eventually developed a secondary pleural echinococcosis and had to undergo four more operations: one thoracophrenolaparotomy and three thoracotomies with marsupialization of the cysts.

Intrabronchial rupture offers a varied symptomatology with different degrees of infection and hazards.

In two cases drainage evacuated a large quantity of hydatid cysts due to persistent or relapsing echinococcosis. One of the patients died from hemorrhage; the other recovered.

In the series of non-hyaline cysts, and particularly among those complicated by intrabronchial rupture, pulmonary resection was the predominant treatment followed by marsupialization and Posadas' operation. Lobectomy was the type of resection most frequently used, favorite indications being residual cavities and pericystic bronchiectasis. Pneumonectomy was performed on a lung in which a hydatid cyst and a tuberculoma were found.

Marsupialization was performed in cases of infected cysts, in which either their general condition or technical difficulties determined the inadvisability of pulmonary resection.

Posadas's operation was employed in small but complicated cysts, or in those cases in which their localization would have proved dangerous.

Three deaths were registered in the 65 non-hyaline cases. One was case of recurrent echinococcosis following application of drainage in the area of a previous marsupialization. Death was caused by postoperative pulmonary hemorrhage.

The remaining deaths occurred after lobectomy had been performed. One, due to a lower nephrosis and another to intracystic hemorrhage and bronchial flooding during operation.

The treatment of choice in 124 cysts was evacuation of the parasite and pulmonary resection. For the latter different techniques were employed ranging from partial atypical resection with suture of the bronchial orifices to total pneumonectomy.

Mortality was limited to three cases (2. 6 per cent) and death recorded only in cases of complicated non-hyaline cysts.

Multiple Pulmonary Echinococcosis

In 17 out of 104 cases, echinococcosis proved to be multiple. Localization was bilateral in five and unilateral in 12.

In 16 multiple echinococcosis was considered primary. In one case it was secondary to pulmonary hydatidosis.

Apart from this particular case in which surgical treatment was limited to the large cysts, all cases showed satisfactory evolution.

Operative Technique

Hydatid cysts with a presumptive or confirmed diagnosis were operated upon under general anesthesia in a closed circuit following laryngotracheal intubation with cyclopropane-ether-oxygen. Induction was obtained with intravenous pentothal sodium. In some cases curare was injected and cyclopropane replaced by nitrous oxide.

A wide posterolateral thoracotomy with resection of posterior fragment of two or three ribs permits a sufficiently comfortable pleurotomy exploration of the lung and performance of the most suitable operation.

Cystostomy or pnuemocystostomy and evacuation of the parasite are usually preliminary measures.

A decision is reached: bronchial suture, closing of the adventitia, marsupialization in the most suitable spot or pulmonary resection. The type and extension will be determined by the size of irreversible lesions or by technical needs in each particular case.

Technique varies according to circumstances but always consisting of the dissection and individualization of those vasculobronchial elements of the pedicles, and hermetic bronchial suture protected by soft neighboring tissue or by the pleura.

Mobilization of the lobes with firm vascularized adhesions to the thoracic

wall particularly those subjected to a former marsupialization is performed as a last resource after control of the pedicle.

This plan suppresses the blood flow into the lobe, diminishes hemorrhage from dissection of the adhesions and excludes the bronchocavitary system.

Temporary pleural drainage connected to an irreversible or gentle aspirating system helps in lobular re-expansion and evacuation of transudates.

Dissection of the remaining lobes is conditioned by the technical demands of the resection and the need of allowing sufficient expansion. Hence it is unwise to sever the superior connection of the lobe with the thoracic apex; on the other hand, it is useful to cut the pulmonary ligament to facilitate displacement of the inferior lobe.

Antibiotics, (penicillin, streptomycin and terramycin) given parenterally or orally before and after operation are also inserted into the pleural cavity at the end of the surgical operation.

Bronchoscopy is performed either during ablation or at the end of it, according to circumstances.

Bronchial obstruction by particles of parasitic membranes, pus or blood calls for careful attention to the permeability of the bronchial tree and prompt endobronchial aspiration.

Catheters of the Magill, Crafoord or Björk-Carlens type are useful for blocking off the diseased section right from the beginning of the anesthesia. We have also employed Guebauer's with equally satisfactory results.

Thoracotomy offers the advantage of treating several pulmonary cysts or pulmonary and hepatic cysts in a single operation.

The immediate benefits demonstrated when hydatid cysts are treated by resection rather than by any other surgical procedure are the following:

Shorter period of warding
First hand healing of the operative wound
Fewer and less serious complications
Lasting benefits obtained:
Improved functional thoracic readjustment
Absence of residual pulmonary cavities
Lack of symptoms from residual cavities, bronchiectasis, etc.

Theoretically hydatid cysts of the lung are generally peripheral, yet the finding of cysts surrounded by pulmonary parenchyma calls for reflection regarding the truth of this statement. It is possible that the hydatid cyst is peripheral with regard to the segment where it originally developed, but segmentary apposition in the structure of the lobes might explain the deep location in the organ.

Surgical intervention on hydatid cysts of the lung should be performed in well equipped centers by experienced operators. It is indispensable for surgical, biological and functional success.

In surgical treatment three objectives must be kept in mind: liberation of echinococcosis, healing of the induced organ and functional recovery.

Surgical treatment as set by Posadas's (closure without drainage) with any of its modifications, or pulmonary resection (atypical, segmentary or lobular) may be indicated; they are not excluded.

Rupture of the cyst into the pleura permits the evacuation of the parasite partially or totally lodged in the lung or in the pleura.

Surgical decortication achieves pulmonary reexpansion and occlusion of the pleural cavity. Furthermore, the technique must be adjusted to the treatment of empysemas or hydropneumothorax from pulmonary perforation.

All lesions caused by chronic bronchoalveolitis, bronchiectasis or secondary sclerosis are important in the area near chronic infected hydatid cysts. The irreversible nature of these lesions justifies the performance of pulmonary resection.

SUMMARY

A brief summary is made of the diagnosis and surgical treatment of hydatid cyst of the lung.

The authors analyse the experience obtained at the Institute of Thoracic Surgery (Buenos Aires) in the treatment of 124 cases of hydatid cysts, on whom 59 pulmonary resections were performed, 39 marsupializations, 15 Posadas's operations and four other procedures according to the pathologic configuration of the cysts and conditions of the lung.

The importance of pneumonitis and bronchiectasis secondary to chronic infected cysts is pointed out.

RESUMEN

Los autores hacen un breve resumen del diagnóstico y del tratamiento quirúrgico del quiste hidatídico del pulmón (o hidático).

Analizan la experiencia obtenida en el Instituto de Cirugía Torácica de Buenos Aires en el tratamiento de 124 casos de quistes hidatídicos en los que se llevaron a cabo 59 resecciones pulmonares, 39 marsupializaciones, 15 operaciones de Posadas y 4 de otros procedimientos de acuerdo con la configuración pathológica de los quistes y las condiciones del pulmón.

Se señala la importancia de las neumonitis y la bronquiectasia secundaria a los quistes crónicamente infectados.

RESUME

Les auteurs exposent rapidement le diagnostic et le traitement chirurgical du kyste hydatique du poumon.

Ils analysent l'expérience acquise à l'Institut de Chirurgie Thoracique de Buenos-Aires, grâce au traitement de 124 cas. Parmi ceux-ci, on exécuta 59 exérèses pulmonaires, 39 marsupialisations et 15 opérations de Posada. Dans quatre autres cas, on utilisa des procédés divers nécessités par l'aspect anatomique du kyste et l'état du poumon.

Les auteurs insistent sur l'importance de l'atteinte parenchymateuse et des dilatations bronchiques secondaires aux kystes chroniques infectés.

CASE REPORT SECTION

Necrosis and Rupture of Pulmonary Artery Following Interlobar Empyema, with Recovery*

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Necrosis of the wall of the pulmonary artery with consequent sudden rupture and ultimate survival of the patient is rare. In fact a case has not been found described in the literature. That such an episode should result in a high mortality is to be expected unless measures to control the hemmorhage were immediately available and promptly instituted.

CASE REPORT

E. W. B., a 29 year old, white male, railroad section worker was admitted to the Hamburg State Sanatorium on July 12, 1951. On May 17, 1951, he experienced chills, cough and expectoration of grayish, yellow, thick, tenacious sputum, described by him as "a bit like glue." A few days later he developed continuous fever associated with chills and sense of tightness in his chest, and pain in his lower right hemithorax, influenced by respiration. His sputum now contained bright red blood, with associated frank hemoptysis. Chills and fever increased in severity, although he had received administrations of penicillin, streptomycin, aureomycin, and "other medicine," and he was admitted to a general hospital on May 28, 1951.

A review of past medical history, family history, social history and various systems was con-contributory.

Physical examination revealed a well developed, well nourished, young adult, white male, well orientated, intelligent and cooperative, who appeared acutely ill, sweating, cold and slightly cyanotic. The positive physical findings were otherwise limited to the chest, where the percussion note was dull to flat over the right lower lobe area and auscultation revealed diminished breath sounds with showers of crepitant and coarse rales over the same area.

X-ray film of the chest on admission (May 28, 1951) confirmed the provisional diagnosis of pneumonia (Fig. 1) and likewise suggested the presence of one or more

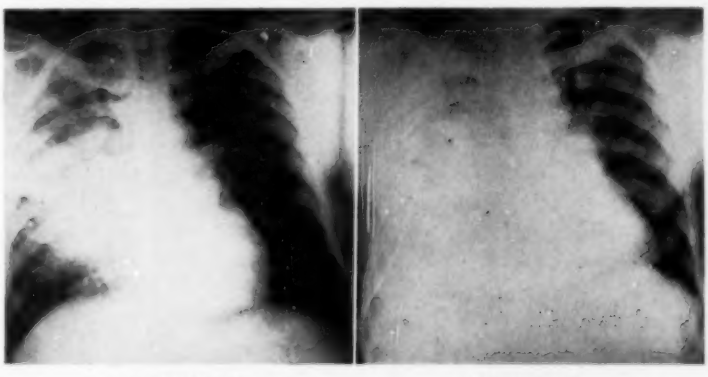

FIGURE 1 FIGURE 2

Figure 1: Roentgenogram of patient on admission to General Hospital (5/29/51).
Figure 2: Roentgenogram showing postpneumonic "pleural effusion" (6/12/51).

*From the Hamburg State Sanatorium.

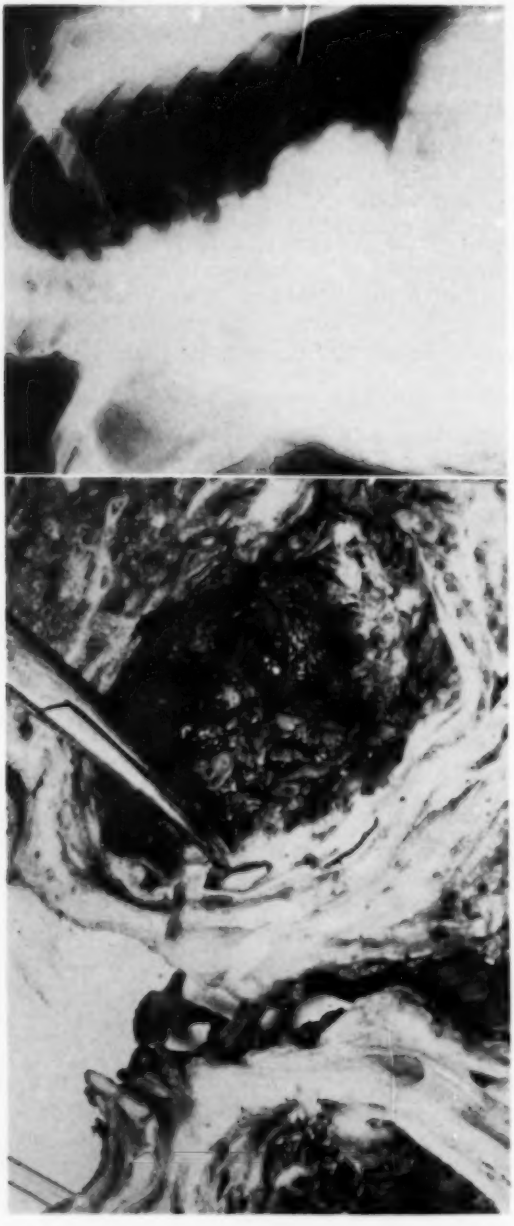

FIGURE 3

FIGURE 4

Figure 3: Close up showing empyema area and "clamped" arterial perforation.
Figure 4: Final postoperative (Thoracoplasty and Pneumonectomy) Roentgenogram.

pulmonary abscesses. He was kept on antibiotics. He continued to be cyanotic and dyspneic. His temperature was 103° orally, pulse 86, respirations 22 per minute, and the blood pressure 118/70. Anticipated clinical improvement did not occur but he became progressively more ill.

On June 11, 1951 (Fig. 2) a second roentgenogram revealed a total disappearance of the underlying lung detail on the right side. A diagnosis of massive right sided pleural effusion was made. Three hundred cc. of thick, purulent, "musty like," peculiarly foul smelling material was aspirated and replaced by a quantity of air sufficient for diagnostic purposes. A third fluoroscopic and x-ray film study was made on June 26, 1951 (Fig. 3).

Following this on June 29, 1951 thoracotomy was performed and the pleural space dependently and adequately drained. Except for a short period of limited improvement, his condition not only remained unsatisfactory but showed a steady, gradual "down hill" course, as evidenced by a continuing septic type temperature, increased pulse rate, and disintegration of the clinical status.

He was admitted to the Hamburg state sanatorium on July 12, 1951, severely septic and critically ill. His temperature was 101.4° F., pulse 92-100, and the respirations 24-32 per minute. He was unable to sit up, was dehydrated, his right arm and leg showed marked pitting edema. He was treated with intravenous fluids, protolysates, transfusions, injectable and oral vitamins, oxygen by nasal catheter and aureomycin (empirically).

Although his clinical condition showed minimal improvement, his temperature dropped by lysis to normal and remained so until July 19, 1951, the seventh day of hospitalization on the surgical service when at 9:20 A.M., he developed profound intra-thoracic hemorrhage. The bleeding took the form of a stream approximately one inch in diameter and gushing out of the hard rubber thoracotomy tube for an estimated three to four inches. Exsanguination was prevented by rapid packing of the chest cavity. Following this, his temperature again rose to 104° F. orally and thereafter followed a daily septic pattern. His clinical condition took a precipitous turn for the worse and surgical intervention was unquestionably contraindicated, although considered inevitable if he was to survive. Multiple transfusions, antibiotics, liver, iron and intravenous therapy was employed in an effort to condition him for possible operation.

Dressings rapidly loosened, became saturated with blood, and putrid exudates, and frequent periodic repacking was necessary. Blood loss, at the time of each redressing, was kept to a minimum by speed in repacking the thoracic space. The red blood cell count and hemoglobin showed an alarming drop to 1,300,000 and 34 per cent respectively, but continued transfusions succeeding in elevating the red blood cell count to 2,120,000 and the hemoglobin to 61 per cent. Hemolytic staphlycocci pneumomocci, N. catarralis H. influenzae, and alpha streptococci were isolated bacteriologically on various dates. The electrocardiographic and heart studies showed no pathological changes.

At this time, the decision to intervene surgically was made as the intrathoracic bleeding was continuing and adequate control was becoming progressively more difficult in spite of meticulous packing.

On August 11, 1951, a difficult right pneumonectomy was performed (Fig. 3). The post-operative course was uneventful with return of temperature to a maximum of 100° F. orally in three days. Clinical improvement was exceedingly rapid and a nine-rib thoracoplasty was performed on September, 1951, with maximum temperature rise of 99.4° F. post-operatively. All drainage had ceased and the wound was thoroughly healed by December, 1951. He is now preparing to return to some form of gainful occupation January 15, 1952, (Fig. 4).

Operation: Technically the operation followed the accepted procedure with approach through the bed of the fifth rib. In-dwelling canulae facilitated the administration of intravenous and intra-arterial blood. In all 5,000 cc. of whole fresh blood were administered during the course of the operation (two hours, 27 minutes).

As the thorax was opened a large quantity of necrotic material was removed, along with the major portion of the intra-thoracic packing, however, continuous pressure had to be maintained over the hilum of the lung throughout the procedure, releasing but a small area at a time so that dissection could proceed. A final "clamp" was applied, relatively blindly, to what was first supposed and later found to be the pulmonary artery. The dissection was then completed rapidly and the bronchus repaired with utmost dispatch, open drainage of the space was maintained.

The subsequent nine-rib thoracoplasty followed the classical technique with maintenance of the open drainage until the infected pleural space was finally closed (Fig. 4).

Gross Description—Right Lung: The lung is fixed in formalin and moderately distorted. Between the upper and lower lobes there is a cavity which occupies the

interlobar fissure but does not appear to involve the lung itself. This cavity extends into the hilum and is filled with purulent exudate and blood clot. When the specimen is sectioned into two parts, from apex to base, it is seen that the inner border of the cavity, which appears to have an interlobar empyema, is formed by the lower lobe bronchus and the pulmonary artery branch to the lower lobe. There is, at this point a 1.3 centimeter opening in the artery. The opening involves about half the circumference of the vessel. The edges of the defect are rounded as if it had been present for some time. The lung is atelectatic but is apparently not involved in the pathologic process.

Microscopic Findings—Lung: The sections show that the material in the cavity is an infected thrombus. The lung is not involved except for atelectasis. The artery shows inflammation of the wall near the site of erosion. The edges of the defect are rounded as if it had been present for some time.

Discussion

This case presents a fertile field for speculation not only from the standpoint of the fortunate circumstances but also from the standpoint of etiology. The possibility that the hard rubber drainage tube might have impinged against the artery wall with consequent erosion, was considered but this possibility abandoned. The tube had been removed and replaced at frequent intervals. Furthermore it was definitely known that the tube (Latex Rubber Fenestrated) projected into the pleural space at an angle away from the site of the perforation (the site of the perforation being posterior and medial, while the tube was posterior, laterally and upwards). Likewise the tube was considerably shorter than would have been required to come in contact with the damaged artery wall.

From the etiological viewpoint, the problem resolves itself purely into one of speculation and deduction. There is no doubt that this patient's initial lesion was pneumonic. However, due to the administration of numerous antibiotics prior to his first hospitalization, the bacteriological studies upon the sputum and pleural secretions failed to reveal organisms specifically characteristic or particularly significant. In view of the discription of "glue like" sputum, and in view of the severe necrosis accompanying the infection, it is speculatively possible that we were dealing with Friedlander's bacillus infection. I (A. R. J.) have seen one similar case with proved diagnosis of Friedlander's pneumonia, subsequent empyema but without vascular damage.

The treatment principles were simple and not particularly spectacular, however, three phases are worthy of some emphasis.

First—the snug, careful packing of the bleeding area has long been stressed by obstetricians and gynecologists. This principle carried the patient through the critical period up to the time of operation.

Second—the judicious use of intravenous fluids, protolysates, electrolytes and whole blood transfusions in conjunction with other indicated medications including vitamins, liver extract and iron, aided materially in sustaining and in improving, to some degree, a profoundly ill patient.

Lastly, a well trained and integrated nursing and surgical team, working as a unit reduced materially, the blood loss and operative trauma to a bare inevitable and shortened the operating time to a minimum with consequent survival of a patient predicted not to survive the surgical ordeal.

SUMMARY

1. A case of presumed interlobar Friedlander's empyema is presented wherein necrosis of the pulmonary artery occurred.

2. Treatment consisted generally of adequate packing of the area, attention to the blood, and electrolyte balance in general physiological state and antibiotic therapy, also pneumonectomy and thoracoplasty with ultimate recovery.

RESUMEN

1. Se presenta un caso de supuesto empiema interlobar de bacilos de Friedlander en el que ocurrió necrosis de la arteria pulmonar.

2. El tratamiento en general, consistió de taponamiento adecuado del área, atención a la provisión de sangre, balance electrolítico y en general, estado fisiológico y antobioticoterapia y también neumonectomía y toracoplastía con recuperación final.

RESUME

L'auteur rapporte un cas probable de pleurésie purulente interlobaire à bacilles de Friedlander, avec nécrose de l'artère pulmonaire.

Le traitement comporté d'une façon générale le tamponnement de la région atteinte, la surveillance du sang, et de l'équilibre électrolyte, le traitement antibiotique, ainsi que la pneumonectomie et la thoracoplastie. La guérison survint finalement.

Mediastinal Hernia

WITH SUGGESTED DESCRIPTIVE TERMINOLOGY AND REPORT OF AN UNUSUAL CASE

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Mediastinal hernia is the projection through the mediastinum of the contents of one pleural space into the opposite hemithorax. Parietal pleura from each hemithorax invests the hernia. Widespread use of artificial pneumothorax in the therapy of pulmonary tuberculosis following its introduction, in principle, in 1875[1] created conditions mechanically necessary for development of mediastinal hernia, and Nitsch's early description[2] drew attention to the complication. It has been estimated that mediastinal herniation follows 10 per cent of therapeutic pneumothoraces[3]. Clinically silent in most instances, it usually is discovered incidentally or as a complication of artificial pneumothorax.

Required for development of hernia of the mediastinum are inequality

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of pressures within the two hemithoraces, an intact mediastinum, and a degree of fixation of mediastinal structures.

The pressure difference results from unequal pressure changes within the hemithoraces. Pressure in either side may be increased or decreased, or both may be increased or decreased so long as they remain unequal.

Pressure exerted against the mediastinum induces herniation toward the side of lesser pressure through any of three areas whose anatomic characteristics predispose them to this defection. The most commonly involved site, immediately behind the sternum slightly above and in front of the heart, results in the anterior superior mediastinal hernia. The second most common site is situated just above the diaphragm between the vertebral column and the esophagus as it courses forward to traverse the diaphragm. Here occurs the posterior inferior mediastinal hernia. Rarely seen is the posterior superior mediastinal hernia, protruding between the esophagus and the third to fifth thoracic vertebrae, separated from the posterior inferior weak spot by the azygos vein.[4]

An intact mediastinum is necessary for a pressure difference to exist, because communication between the two sides of the chest would permit equalization of their pressures.

A degree of mediastinal fixation is necessary because laxity here permits shift of the mediastinum *in toto* rather than herniation. Mediastinal hernia is differentiated from mediastinal shift by pleural protrusion beyond the trachea into the opposite hemithorax.

Any mechanism of unequal pressures within the hemithoraces may result in mediastinal hernia. Artificial pneumothorax,[1,5] massive pleural effusion or empyema,[6] cystic disease of the lung, pulmonary emphysema,[7] and primary pleural mesothelioma[8] may produce mediastinal hernia by increasing pressure within a hemithorax during expiration. The hernia moves away from the diseased side to enter the uninvolved side, and is called a *pulsion* hernia.

Massive atelectasis,[9] bronchostenotic lesions,[10] foreign body aspiration,[11] extensive unilateral suppurative bronchiectasis, congenital hypoplasia of a lung,[12] and inflammatory-fibrotic lung disease (including late sequelae of pneumothorax,[11] hemothorax, pyothorax, chest trauma, and intrathoracic procedures[13]) act to induce mediastinal hernia by decreasing pressure within a hemithorax during inspiration. The hernia moves away from the uninvolved side to enter the diseased side. Those so produced have been termed *traction* hernias.[14] It is doubted, however, that true traction hernia occurs, in the sense that fibrous bands exert traction upon the opposite mediastinal pleura and draw it across the midline. A more likely mechanism involves decrease in volume of a lung due to one or more of the above causes, leading to a pressure difference between the two hemithoraces. This difference increases during inspiration and combines with compensatory increased volume of opposite uninvolved lung to produce bulging toward the diseased side.

It may prove desirable to designate a mediastinal hernia as *ipsilateral* when it moves toward the side that contains the disease process, and as

contralateral when it moves away from the causative disease.

Ipsilateral (traction) and contralateral (pulsion) hernias may be differentiated by their movement during respiration. During inspiration, the hemithorax containing lung tissue of diminished volume or of decreased expansile capacity (atelectasis, fibrosis, etc.) develops greater negative pressure than the normal opposite side. Ipsilateral hernias, therefore, are pushed into the diseased side of the chest during inspiration and return toward the midline during expiration. Thus, routine inspiration chest roentgenogram may demonstrate the ipsilateral mediastinal hernia (Figure 1). With pneumothorax, massive pleural effusion, cystic disease of the lung, etc., the diseased hemithorax cannot contract as well as its uninvolved counterpart. During inspiration, each hemithorax increases in volume, minimizing the pressure difference between the hemithoraces produced by the lesion. During expiration, however, the uninvolved side contracts more than does the abnormal side, which is maintained at partial expansion by the space-taking lesion. The pressure difference so produced pushes the hernia away from the diseased into the good side. Thus, an expiration chest roentgenogram may be required to show a contralateral mediastinal hernia not demonstrated by the usual record made during full inspiration.

Uncomplicated mediastinal hernia itself rarely causes symptoms. Occasionally, dyspnea, tachycardia, palpitations, weakness, and faintness are noted. These appear to result from pressure upon the mediastinal structures, embarrassment of the heart and great vessels, or to tension upon visceral nerves. Circulatory failure has been reported to result from pressure upon the heart by mediastinal hernia.[15]

There are no physical findings pathognomonic of mediastinal hernia. Careful percussion over the sternum may reveal changes in resonance as an anterior or large posterior mediastinal hernia shifts with deep inspira-

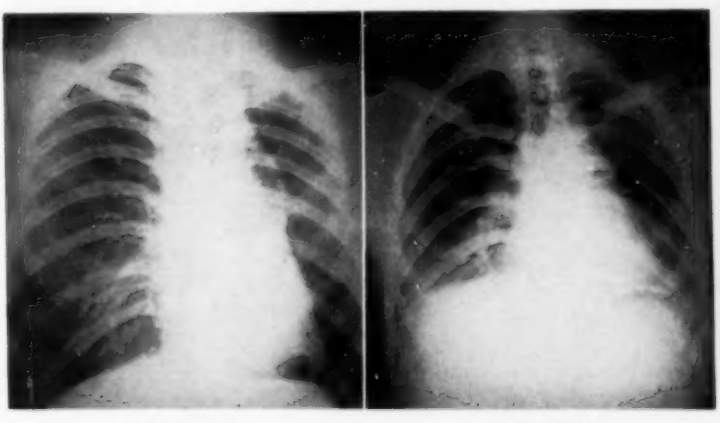

FIGURE 1 FIGURE 2

Figure 1: Routine chest roentgenograms taken during inspiration, showing shift of mediastinum toward left and herniation of right upper lobe into left hemithorax.—*Figure 2:* Chest roentgenogram taken during expiration, showing shift of mediastinum back toward midline and retraction of hernia into mediastinal shadow.

FIGURE 3A

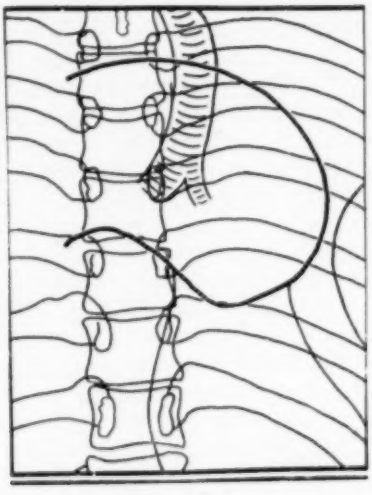

FIGURE 3B

Figure 3A: Spot film roentgenogram of mediastinum showing expansion of hernia during inspiration.—*Figure 3B:* Line drawing taken from Figure 3A.

FIGURE 4A

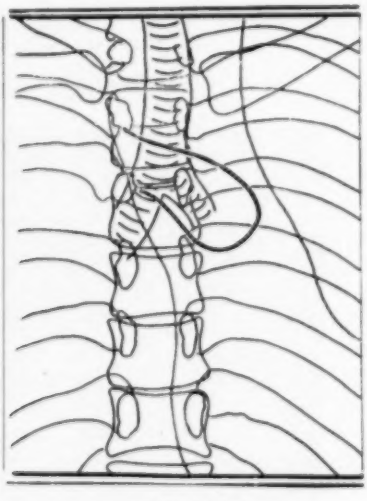

FIGURE 4B

Figure 4A: Spot film roentgenogram of mediastinum showing decreased size of hernia during expiration.—*Figure 4B:* Line drawing taken from Figure 4A.

tion. Should an ipsilateral hernia overlie atelectatic lung, the presence of breath sounds and resonance may lead to an erroneous impression of normal underlying lung.[9] A diagnosis can be made if the possibility of mediastinal hernia be considered in relation to any chronic thoracic disease which is likely to cause a shift of the mediastinum. Recognition of mediastinal shift should stimulate search for mediastinal hernia, utilizing roentgenograms of the chest taken at full inspiration and full expiration. Fluoroscopic examination of the chest may establish the diagnosis, the hernia appearing as a highlight with a dark curving border, which expands and contracts with respiration (Figures 3a, 3b, 4a, 4b). Posterior superior hernias appear above the level of the sternoclavicular joints.[11]

Bronchography aids recognition of underlying pulmonary causes for the hernia; such as, bronchiectasis, bronchostenotic lesions, and congenital hypoplasia of a lung. Laminography usually is not required but is useful for confirmation of the position and contour of the hernia. Roentgenkymography has been recommended to record movement of the hernia. Bronchoscopic examination verifies the presence of tracheobronchial deviation. It may also reveal torsion of the pulmonary tree about the tracheal axis, visualized as one bronchial orifice shifted forward, the other, backward.[11]

Hernias of the mediastinum may be massive in size,[16] multiple,[17] or bilateral with coexisting ipsi-and contralateral types.[17]

Conditions to be differentiated from mediastinal hernia include cysts of the mediastinum and lung, tumor, loculated effusion, vascular aneurysm, lung cavity, mediastinal abscess, and bilateral empyema.

Although clinically silent for the most part, mediastinal hernia may result in serious complications. Circulatory embarrassment or cardiac failure may result from pressure of the hernia against the heart.[15] If the hernia should not be recognized during intrathoracic procedures, the sac may be perforated inadvertently inducing pneumothorax of the opposite side.[18, 19] Large mediastinal hernias may present externally between ribs or in a supraclavicular fossa as a lung hernia.[20] The hernia may mask abnormal physical signs of underlying diseased lung.[9] It may rupture, causing infection and death.[21]

Correction of the underlying cause, where possible, will correct the hernia. Usually, no therapy is required for the symptomless ipsilateral mediastinal hernia. If contralateral hernia should complicate artificial pneumothorax, withdrawal of air may suffice. Induction of opposing pneumothorax may stabilize the mediastinum. Extreme fibrosis and atelectasis due to tuberculosis may necessitate pneumonectomy or thoracoplasty.

The following case of ipsilateral hernia of the mediastinum attributed to late effects of external chest trauma is presented as an unusual occurrence and for general clinical interest.

Case History

In September 1951, a 21-year-old white man drove an automobile off the road at high speed and was thrown from the vehicle, sustaining mild concussion with a brief period of unconsciousness. He was hospitalized for three days and treated symptomatically. Generalized myalgia immediately consequent to the accident subsided after a week or two. Since that time he had experienced vague chest soreness upon rotation

of the spine, and intermittent low back pain. Persistence of these symptoms with physical exertion, together with a 15-pound weight loss incident to military duty, prompted him to seek medical attention in November 1952. Past medical and family histories were noncontributory.

He was 70 inches tall and weighed 135 pounds. Temperature, 98.4° F. (36.8° C.); pulse, 88, regular; blood pressure, 130/80 millimeters of mercury in each arm. There was moderate deviation of the trachea toward the left, increased by deep inspiration. The heart was shifted slightly toward the left. Percussion over the sternum during respiration revealed greater resonance during inspiration than during expiration. The lungs were clear and the remainder of the physical examination was within normal limits.

Complete blood count, urinalysis, hematocrit, and erythrocyte sedimentation rate were normal on admission. During hospitalization, the corrected erythrocyte sedimentation rate ranged between 14 and 24 millimeters per hour (normal range 0 to 10 millimeters.) Smear and culture of of gastric and bronchial washings for tubercle bacilli and fungi were negative on three occasions. Papanicolaou preparations of bronchial

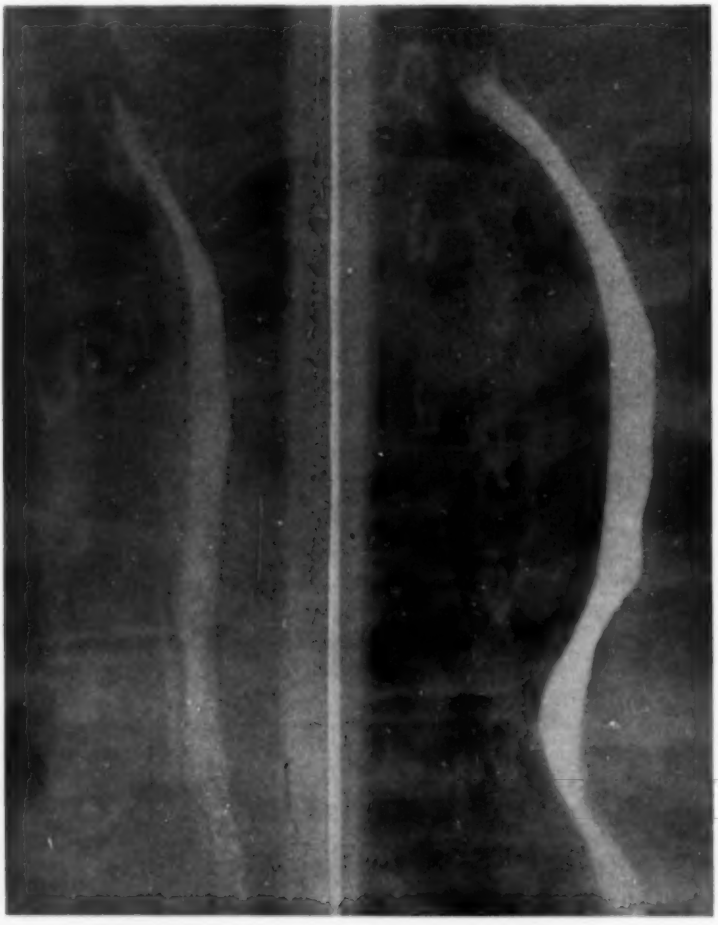

FIGURE 5A FIGURE 5B

Figure 5A, 5B: Esophagrams during expiration (left) and during inspiration (right) illustrating to and fro movement of mediastinal structures during respiration.

washings were negative for malignant cells. Tuberculin (PPD) skin tests first and second strengths were negative on admission and again six months later.

Routine posterioanterior chest roentgenograms (Figure 1) showed the mediastinum to be shifted toward the left, with herniation of the right upper lobe across the midline into the left lung. Chest roentgenogram taken during full expiration (Figure 2) showed the hernia contracted into the mediastinal shadow with shift of the mediastinal structures back toward the midline. Apical lordotic roentgenogram of the chest revealed left apical pleural thickening. Fluoroscopic chest examination showed the diaphragm to move normally. During deep inspiration, the mediastinum moved toward the left and the right upper lobe herniated into the left side of the chest, appearing as a highlight with a dark curving border (Figures 3a, 3b). During expiration, the hernia contracted to merge with the mediastinal shadow (Figures 4a, 4b). Esophagrams (Figures 5a, 5b) and bronchograms confirmed the to and fro mediastinal shift during respiration. There was no evidence of atelectasis of the left upper lung segment, nor of congenital pulmonary defect. Laminagrams of the chest during inspiration confirmed the presence of an anterior superior mediastinal hernia of the right lung into the left. No evidence of mediastinal or lung cyst was noted.

Bronchoscopic examination was performed three times. All of the visualized bronchial orifices were normal except for mucosal edema and injection, most marked on the left, during the first examination. The two subsequent bronchoscopic examinations disclosed no abnormality except for a mildly acute angle of take-off of the left main stem bronchus.

The patient remained afebrile during a six-month period of observation. Chest discomfort remained vague and minimal in severity. He regained weight to 146 pounds and manifested no systemic effects of the intrathoracic abnormality noted by roentgenographic study.

The final impression was that he had an anterior superior ipsilateral hernia of the mediastinum from right to left, resulting from injury sustained in the automobile accident. Presumably, an undetected hemathorax or pleuritis, produced by external trauma to the chest in the accident, had resulted in limitation of capacity of the left lung to expand to fill the left hemithorax during inspiration. The pressure difference from right to left, so created, induced formation of the mediastinal hernia.

SUMMARY

A general discussion of mediastinal hernia is presented, including types, etiology; and anatomic, clinical, and diagnostic features. Pathogenesis of the condition is reviewed. It is suggested that current terminology, *pulsion* and *traction*, does not accurately describe types found.

Descriptive terms, *ipsilateral* and *contralateral*, are offered to denote mediastinal hernias which herniate toward and away from, respectively, the hemithorax containing the causative disease process.

A case summary with roentgenograms is included as an example of ipsilateral mediastinal hernia.

An unusual feature of the case is the apparent causal relationship of external chest trauma.

RESUMEN

Se hace una discusión general de la hernia de mediastino incluyendo los tipos, etiológica y anatómicamente, con las características clínicas y diagnósticas.

Se revisa la patogenia de esta condición. Se sugiere que la terminalogía corriente, empuje y tracción no describe con exactitud los tipos en contrados.

Se ofrecen los términos ipsilateral y contralateral para denotar las hernias que hacen protrución hacia o alejándose del hemitórax respectivo.

Se hace un resumen de casos con roentgenogramas como ejemplos de—hernia ipsilateral.

Una característica desusada el caso es la aparente relación con eltrauma externo del tórax.

RESUME

L'auteur présente une revue générale sur la hernie médiastinale. Il en étudie les formes, l'étiologie, et les aspects de l'anatomie, de la clinique et du diagnostic.

Il examine les hypotheses pathogéniques. Il lui semble que la terminologie habituelle de hernie par "pulsion" ou par "traction" ne correspond pas à la description des différentes formes qu'il a pu relever. Il propose les termes de "homolatérale" ou de "controlatérale" pour désigner la hernie médiastinale se faisant soit dans la direction ou à l'opposé de l'hémithorax atteint de l'affection causale.

Il apporte en exemple des hernies médiastinales homolatérales un cas avec les constatations radiologiques.

Un aspect inhabituel de l'observation semble être dû au fait qu'il est probablement secondaire à un traumatisme thoracique.

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Laryngoptosis,
An Easily Detectable Sign of Pulmonary Emphysema

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Few erroneous diagnoses are made as frequently as that of congestive heart failure in non-cardiac patients with exertional dyspnea caused by pulmonary emphysema, especially if in addition a downward displaced liver is mistaken for a sign of congestion. A history of dyspnea, limited to exertion and absent in recumbency, should evoke doubts concerning its cardiac origin and careful physical examination should further clarify the situation by revealing low position and reduced inspiratory motility of the diaphragm, a relatively small area of dullness over the heart, weak breath sounds, feeble tactile fremitus, prolonged expiration and upper thoracic kyphosis. However, these signs are often overlooked and, unless the well-known "barrel-shaped" chest is present, pulmonary emphysema is not considered. It should be emphasized that the increased antero-posterior diameter, the wide intercostal spaces and the more or less horizontal position of the ribs which constitute the characteristics of the

FIGURE 1

Division of Experimental Medicine, University of Vermont, College of Medicine.

"barrel-shaped" chest, are frequently absent, even in cases of severe emphysema. It is a common event to see non-cardiac emphysematous individuals with anorexia, nausea and weight loss, caused by prolonged, useless digitalis administration and salt restriction, and in a state of mental depression because of the unabated persistence of their alleged heart disease.

In view of the frequency of such diagnostic and therapeutic mistakes, it may be useful to call the attention of practicing physicians to a rarely heeded, yet easily recognizeable clinical sign which facilitates the detection of pulmonary emphysema. The late Professor H. Eppinger, head of the First Medical Clinic of the Univrsity of Vienna, often astonished his staff at ward rounds by making in newly admitted patients the correct first-glance diagnosis of emphysema, even before having heard the patient's history or having seen him undressed. His reasoning was based on the conspicuously small distance between the protruding thyroid cartilage and the upper edge of the sternum (fig. 1). This distance may be so short that the lower edge of the thyroid cartilage seems to actually touch the sternum, and if the examiner's fingertip is placed in the sternal incisure (fig. 1F) it may be caught between the latter and the descending cartilage when the patient takes a breath.

The cause of this characteristic phenomenon is the downward displacement of the diaphragm together with the attached mediastinal structures, including the trachea and larynx, combined with an accentuation

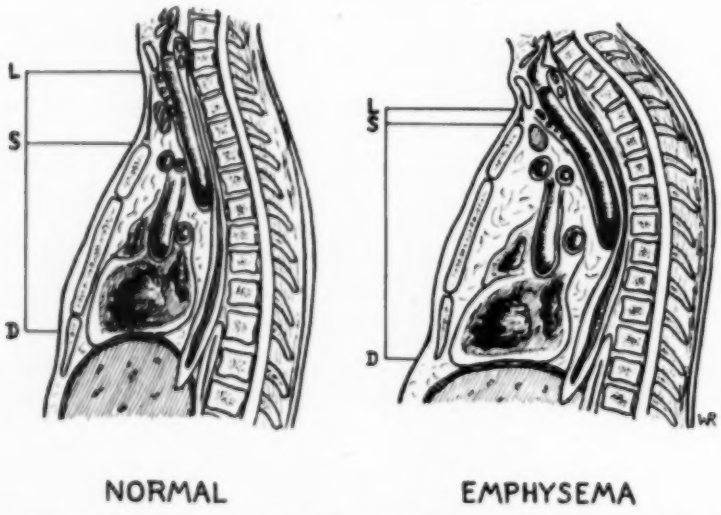

FIGURE 2: Sagittal section of the neck and chest, indicating the lowering of the diaphragmatic convexity (D) in the presence of pulmonary emphysema which augments its distance from the incisure of the manubrium sterni (S) and reduces the distance between the latter and the lower edge of the thyroid cartilage (L): "laryngoptosis." Note also the forward tilting of the thyroid cartilage due to the accentuated curvature of the upper thoracic and cervical spine.

of the upper thoracic spinal curvature (fig. 2) which permits the thyroid cartilage to lean forward and to approach the immobile sternum to a maximal degree. In normal persons, even in those with a short neck, the above-mentioned prerequisites for the phenomenon of "laryngoptosis" are lacking and thus the cartilage-sternum interval remains larger than in emphysematous individual.

An accompanying feature, the protrusion of the sternocleidomastoid muscles, usually gives the optical impression as though these muscles were forcefully contracted in an effort to improve respiratory efficiency. However, it is easy to convince oneself by palpation that both muscular columns are soft and flabby and that they protrude only as the result of an abnormal passive relaxation due to the shortened distance between their cranial and sterno-clavicular insertion points. This peculiarity constitutes an additional distinction of the emphysematous from the constitutionally short-necked, normal individual.

In women, afflicted with emphysema, the above described changes are less strikingly visible because the thyroid cartilage is smaller and flatter (fig. 3) and there is a lesser tendency toward upper thoracic kyphosis.

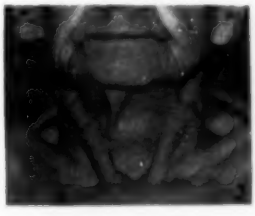

FIGURE 3

SUMMARY

In male patients, the clinical recognition of pulmonary emphysema is facilitated by the presence of an abnormal shortening of the distance between the visible or palpable lower edge of the thyroid cartilage and the upper edge (incisure) of the manubrium sterni. This phenomenon may be designated as "laryngoptosis." It is usually accompanied by a protrusion of the relaxed and shortened sternocleidomastoid muscles.

RESUMEN

En los enfermos de sexo masculino, el descubrimiento clínico del enfisema pulmonar se facilita por la presencia de un acortamiento anormal de la distancia entre el borde visible o palpable inferior del cartílago tiroides y el borde superior del manubrio del esternon u horquilla.

Este fenómeno puede ser designado como "laringotosis".

Generalmente es acompañado de protrusion de los músculos esternocleidomastoideos acortados y relajados.

RESUME

Chez les malades de sexe masculin, le diagnostic clinique d'emphysème pulmonaire est facilité par une diminution anormale de la distance qui sépare l'angle inférieur du cartilage thyroïde que l'on peut voir ou palper et l'angle supérieur du manubrium sternal. On peut désigner ce phénomène sous le terme de laryngoptose. Il est généralement associé à une exubérance des muscles sterno-cléido-mastoïdiens, relâchés et raccourcis.

Editorial

Diffuse Fibrosing Interstitial Pneumonitis (Hamman-Rich Syndrome)

Of all the problems common to the field of chest diseases there is probably none more challenging than the differential diagnosis of diffuse pulmonary lesions. Seemingly endless are the diagnostic possibilities; clinical findings tend to be obscure; and seldom are the usual laboratory tests of any help whatever. However formidable may appear the establishment of a correct diagnosis under these circumstances, it is far less difficult than it was a few years ago, when most of the pathologic processes responsible for extensive bilateral pulmonary involvement were poorly understood. Although much of the mystery surrounding this group of diseases is gradually disappearing, one disease at least, viz., diffuse fibrosing interstitial pneumonitis of the type first described by Hamman and Rich, remains almost as inscrutable today as when it was originally reported nearly 20 years ago.[1] The original concept of this disease has been considerably broadened, it is true, but despite a current display of interest in this entity, the etiology is still unknown, the diagnosis continues to be made by a process of elimination, and no satisfactory treatment has yet been devised. A detailed analysis of this unique syndrome has recently appeared elsewhere.[2] Several features deserve re-emphasis.

Diffuse fibrosing interstitial pneumonitis is an acute or chronic disease of the lungs in which the clinical picture is dominated by cough, dyspnea and cyanosis. About 50 per cent of patients show some degree of cor pulmonale. The disease may proceed with explosive rapidity to death within several weeks or follow a more protracted course extending over many years. Irrespective of its acute or chronic nature progressive impairment of respiration eventually leads to dyspnea and cyanosis at rest, with the patient finally dying from right heart failure or pulmonary insufficiency. The roentgenographic pattern varies and is indistinguishable from diffuse nodular or reticular shadows due to other causes.

In their gross appearance the lungs are quite distinctive. They are usually firm, rubbery and non-collapsible with a dry granular texture on section. Certainly the most singular aspect, however, is their histologic composition. Extending throughout the pulmonary interstitial tissue is a pronounced proliferation of granulation tissue, connective tissue elements, and chronic inflammatory cells. Alveoli are thus encroached upon and in the advanced stage extensively obliterated. The alveolar lining cells undergo a cuboidal metaplasia and sheets of these cells can be found within the alveolar spaces, sometimes producing an appearance reminiscent of pulmonary adenomatosis. There is a notable dearth of purulent exudate, and intra-alveolar organization is not seen to any significant degree.

The diagnosis may be suspected on clinical grounds but ultimately hinges upon the demonstration of the more or less typical microscopic

picture in sections obtained from lung biopsy or autopsy. Two essential requirements are the absence of any demonstrable etiologic organism and the lack of a significant acute inflammatory response.

To date only 27 well-authenticated cases have appeared in the literature. Quite a few others have been alluded to in a manner too fragmentary to corroborate their specific identity. The fact that 18 of the acceptable cases have been reported since 1950, suggests that the disease is not as rare as is commonly believed. It is not unconceivable that it is actually increasing in frequency.

A perusal of the literature will show considerable variation in terminology. Probably the most accurate designation and certainly the most descriptive is "diffuse fibrosing interstitial pneumonitis."[3] Unfortunately, in order to indicate precisely what is meant, it is almost always necessary to qualify the term with the phrase "of the type described by Hamman and Rich." Such terminology is so intolerably cumbersome that there would appear to be some merit in the recently proposed designation, "the Hamman-Rich syndrome."[2] The conciseness and specificity of this term should compensate for any objection to the use of eponyms.

Its etiology, and there is no assurance that there is only a single cause, has so far escaped detection. Whenever this subject is discussed, a viral origin is invariably mentioned. Despite repeated failures to isolate a virus, this hypothesis cannot be disregarded. A familial tendency has been noted in several instances,[2,4] but the significance of this fact is not clear. Perhaps the most intriguing proposal is the possibility that the Hamman-Rich syndrome represents one of the collagen diseases confined to lung. It is well known, of course, that diffuse fibrosis of the lungs accompanies a number of the collagen diseases. Although the histology does not as a rule approximate the cellular proliferation seen in the Hamman-Rich syndrome, in several cases it has been identical. A recent report illustrates, moreover, that scleroderma not only can give rise to alveolar metaplasia, but may progress to alveolar (terminal bronchiolar) carcinoma as well.[5] Further evidence of a relationship to the collagen diseases can be found in the increasing reports of two distinct complications of hexamethonium therapy of hypertension, a lupus erythematosus-like disease on the one hand and a Hamman-Rich-like disease on the other.[6,7,8] One group,[7] after witnessing five fatal cases of interstitial pneumonia secondary to prolonged apresoline and hexamethonium administration, state that the lungs were identical pathologically with the description of Hamman and Rich. The only published pathologic study of such cases[9] does show a strong resemblance to the Hamman-Rich syndrome, except for the prominence of organized fibrinous material within alveoli. It is questionable whether a comparable etiologic mechanism accounts for both diseases, but there is no doubt about the need for further investigations along this line.

Without exception all forms of therapy have been disappointing. In one acute case a most dramatic remission with concomitant radiographic clearing resulted from the administration of ACTH, but upon withdrawing this drug the patient experienced an equally dramatic exacerbation leading to

his death. A similar experience with two additional cases prompted the writers[2] to urge considerable discretion in the use of cortisone and ACTH in the treatment of diffuse pulmonary lesions. In the absence of significant symptoms hormone therapy should not be used for the treatment of diffuse indeterminate pulmonary disease, because most such patients pursue a relatively benign course. Patients with chronic disease should probably not receive cortisone and ACTH, since long-established fibrosis precludes fibrolysis. If these endocrine substances are to be utilized, it should be in the early, severe and otherwise unresponsive case. Once instituted, a permanent maintenance dose might be the safest course to follow. If withdrawal is contemplated, the utmost caution should be exercised, for even the prompt reinstitution of massive doses of cortisone and ACTH failed to avert a fatal outcome in these cases.

Obviously, the problems related to this disease, their implications and their management, will be resolved only by the study of many more such cases. The reporting of all available material is to be enouraged, for in this way considerable light may be shed on the pathogenesis of this remarkable syndrome.

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The Heritage of A Physician

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The idea that led to the founding of the American College of Chest Physicians was conceived by men who were motivated by a desire to be of service to their fellow physicians and through them, to serve humanity. The Fellowship of the American College of Chest Physicans has continued as an increasing and an international resevoir of accumulated medical knowledge and skill dedicated to the service of mankind.

The background against which an idea is developed is important to all who may be influenced by that given idea. Let us take a look at the background of the art and science of medicine: Background is defined as that which is behind anything and against which it is viewed. The background for the development of the art and science of medicine lies in the fact that the Creator did endow each person with some degree of humanitarianism. The expression of this quality by any one individual depends largely upon the dominance or submergence of this humane instinct and the conditions prevailing at a particular time. Records reveal the fact that in the earliest days of man's existence attempts were made by some men to alleviate pain and suffering. Some learned that by removing a thorn or stone or a parasite that the cause of pain was removed. Members of some early tribes learned to use certain plants to stupefy their victims. Crude instruments of stone were used by other men to make holes through the skull to relieve pain or to remove splinters of bone. Rigid splints were used to fix fractures. Medicinal preparations of those early days were unrefined and varied greatly in their potency and the surgical procedures were limited in scope and in effectiveness.

The consciousness of the universal need for knowledge of more effective medicinal agents and greater skill in surgical procedures impelled the physicians of ancient times, as impels us today, to search at home and in distant lands for medical truths. It is readily understood why men of medicine have always been extensive travelers searching in all corners of the universe for knowledge, and that knowledge of medical truths is passed from one people to another even across unfriendly boundaries. Through this liberal exchange of information, all races in all parts of the world have shared in the benefits of this increased knowledge through the good offices of the physician. At times, the light of medical knowledge has been brighter at some spots than at others and at times it has been dim but, it has never been completely extinguished. There have always been those blessed with the urge and will to relieve the ill and suffering. I do not consider it desirable to single out a particular achievement above

*President, American College of Chest Physicians.
Address delivered at Convocation, 20th Annual Meeting, American College of Chest Physicians, San Francisco, California, June 19, 1954.

another for citation nor it is necessary to single out a particular physician or group of physicians for special commendation at this time. All physicians have contributed to the sum total of medical knowledge. We find the names of our common ancestors commemorated on the walls of medical institutions, hospitals, laboratories and schools all over the world.

Times does not permit me to recite the multitude of experiences and calamities which have occurred, each of which has left its imprint upon the people of the time. Knowledge acquired through these experiences caused men of that day and the days to follow to seek for means of preventing or treating the diseases or injuries which occur under such circumstances, each additional experience bringing to light more information over which man must ponder. There is then, no such thing as a modern truth or a modern error, an ancient ignorance or an ancient wisdom. There is only a single truth immutable throughout the ages, a truth which is the basis of all medicine. Medicine is inextractably related by a thousand threads to this origin and the goal is never changing. This will remain true just so long as the physician remains a person endowed with those moral attributes and humane instincts which have at all times characterized the worthwhile physician.

The teacher has been revered and held in high esteem by the physician throughout the Ages. Through long association with the pupil, the teacher, has not only schooled him in medical knowledge but also cultivated and nurtured those moral attributes which mark the man worthy to be called a physician. The pupil binding himself either consciously or unconsciously to teach the art to others without thought of reward.

Certain men who have been honored with the title physician have been guilty of violating the physician's code of services; these men were either unsuited from the very first to enter the medical profession and their selection by their teachers was an error or, somewhere along the line they were not schooled in the moral and humane attributes that should be dominant characteristics of every physician. Such attributes have never been imparted to men through force, they must be cultivated. The only way that desirable moral attributes will be assured in a physician is to select for training only those who present evidence of being by nature and background of good moral fiber. Then, the teachers must, at all levels of his training by precept and example, develop the moral and ethical aspects of the student's personality paralleled with his increasing medical knowledge and responsibilities.

Magnificent buildings and delicate machines are helpful aids in any form of research or medical work and many of our present medical and surgical advances have been hastened through the material support of generous benefactors who have made available needed buildings and equipment but men, not inanimate objects, conceive and develop ideas. The alert inquisitive human mind, fired with a desire to learn, is indispensable in any search for truth. No one country or race of people hold a patent on ideas. Knowledge is garnered from all peoples at all social levels, for "Is there

anything where of it may be said: See, this is new? It hath been already of old time, which was before us."

The great strides in medical knowledge have come through the voluntary efforts of the individual. Once an idea has been shown to have merit, its sponsor has generally won the material support necessary to develop the idea. Remember, pain is not deterred by race, creed, wealth or poverty. Medicine and Surgery know and are restrained by no boundaries. A physician's true worth lies in his knowledge and understanding of things of the past and those of today combined with his ability to anticipate tomorrow's need and apply the sum total in the care of and for the welfare of the patient at hand.

You newly-made Fellows of the American College of Chest Physicians have been selected for fellowship because your sponsors and those who have had the responsibility of passing upon your qualifications have been convinced that you possess the necessary knowledge and skill to enable you to serve your fellow man well. They have also been convinced that your moral attributes and humane instincts have been nurtured to such a degree that young men following in your footsteps should be better physicians through your example. It remains for me to remind you that when you enter a sick room you enter not alone; instead, there stand looking over your shoulder, thousands of physicians past and present, all of whom have contributed something toward your being a physician. Tomorrow, you will stand with them and another will stand in your place. He will have been influenced for better or for worse through your work of today. The value of your contribution will lie largely in your ability to recognize and interpret the hidden or unused truth and to honestly and unselfishly use this knowledge for the good of mankind.

College News Notes

Dr. B. Marr Lanman, New York, New York, has recently been appointed Supervisor of Clinical Investigations and Professional Relations of Schenley Laboratories, Inc.

Dr. Raymond F. Sheely, Gettysburg, Pennsylvania, was recently elected a Vice-President of the Pennsylvania Heart Association.

We regret to announce that **Professor Auguste Rollier** passed away at Leysin, Switzerland on October 30, 1954. He was 80 years of age.

College Chapter News

WISCONSIN CHAPTER

The annual meeting and election of officers of the Wisconsin Chapter was held in Milwaukee, October 3. The new officers are:

President.....Elston L. Belknap, Milwaukee
Vice President.....Karl E. Kassowitz, Milwaukee
Secretary-Treasurer.....Leon H. Hirsh, Milwaukee (re-elected)

NORTH CAROLINA CHAPTER

New officers of the North Carolina Chapter, elected in Winston-Salem, October 15 are:

President.....Ralph E. Moyer, Oteen
Vice-President.....J. D. Murphy, Oteen
Secretary-Treasurer.....Leon H. Feldman, Asheville

POTOMAC CHAPTER

A joint meeting of the Potomac and Virginia Chapters, was held in Washington, D. C., October 31. The following were elected to office in the Potomac Chapter:

President.....George F. Evans, Clarksburg, West Virginia
Vice-President.....Edmund G. Beacham, Baltimore, Maryland
Secretary-Treasurer.....J. Winthrop Peabody, Jr., Washington, D. C.

Elections for the Virginia Chapter will be held in May.

SOUTHERN CHAPTER

Members of the Southern Chapter elected the following officers at their annual meeting in St. Louis, Missouri, November 8-9:

President.....George R. Hodell, Houston, Texas
1st Vice-President.....Alfred Goldman, St. Louis, Missouri
2nd Vice-President.....Robert E. Schwartz, Hattiesburg, Mississippi
Secretary-Treasurer....Joseph S. Cruise, Atlanta, Georgia (re-elected)

ANNOUNCEMENTS

The Mexican Society on Tuberculosis and Diseases of the Respiratory Tract will hold its Sixth National Congress on Tuberculosis and Silicosis in Mexico City, January 23-29, 1955. Further information may be obtained by writing to the Society at: Balderas No. 32-312, Apdo. Postal 7267, Mexico City, Mexico.

The Institute of Industrial Health of the University of Cincinnati will accept applications for a limited number of Fellowships offered to qualified candidates, who must be graduates of a Class A medical school and have completed two years of training in an accredited hospital. Requests for information should be addressed to the Institute of Industrial Health, College of Medicine, Eden and Bethesda, Cincinnati 19, Ohio.

1955 Prize Essay Contest

The American College of Chest Physicians will offer three cash awards for the best essays written on any phase relating to the diagnosis and treatment of chest diseases (heart and/or lungs). First prize will be $250; Second prize, $100; and Third prize, $50. Each winner will also be awarded a certificate of merit. The contest is open to undergraduate medical students throughout the world. The deadline for receipt of manuscripts is April 10, 1955 and instructions for their preparation are as follows:

1) Five copies of the manuscript typewritten in English (double spaced) should be submitted to the Committee on College Essay, American College of Chest Physicians, 112 East Chestnut Street, Chicago 11, Illinois.

2) The only means of identification of the author shall be a motto or other device on the title page and a sealed envelope bearing the same motto on the outside enclosing the name and address of the author.

3) A letter from the Dean or Chairman of the Department of Medicine or Surgery of the medical school certifying that the author is a student at his school.

The Board of Regents has recommended that members of the College affiliated with medical schools be urged to bring the contest to the attention of the student body at their respective schools.

Procedure Simplified in Clearing Medical Motion Picture Films Through U. S. Customs

The Committee on Audiovisual Aids of the American College of Chest Physicians has suggested that the following excerpt from a letter from the United States Information Agency be published for the information of physicians who are asked to loan medical motion picture films to colleagues in countries outside the United States.

"Many producers and distributors of medical motion pictures have been reluctant to loan or rent their films abroad because of the complicated procedures and numerous forms necessary to secure their return through American customs. Recent modification of customs procedures have made it possible to clear films on their return, with the use of but a single form, which should accompany the shipment when it leaves the United States. The new procedure is as follows:

1) Obtain Customs Form 3311 from the U. S. Customs office in your area before you ship the film.

2) Fill out and execute the form, making the following statements in the

REMARKS section:

'It is requested that all other forms required by section 10.1 of the regulations be waived. These films contain no obscene or immoral matter, nor any matter advocating or urging treason or insurrection against the United States or forcible resistance to any law of the United States, nor any threat to take the life of or inflict bodily harm upon any person in the United States.'

3) Affix the form to the outside of the film can or container in an envelope marked 'Documents for U. S. Customs.' Tell the consignee to see to it that the form is still on the can WHEN THE FILM IS RETURNED.

"The Customs Officer at the port of entry will remove the form when the film is returned, and find on it all the information he needs to enable him to admit the film duty-free. The procedure applies to motion pictures valued at not to exceed $250.00."

Obituary

LEWIS J. MOORMAN

Educator, Organizer, Historian and Beloved Physician

1875-1954

During the 17th annual meeting of the National Tuberculosis Association held in New York City in 1921, Dr. Lewis J. Moorman entered into a discussion concerning the importance of teaching the normal chest to medical students. This was the beginning of a close friendship that continued until his death. He had already been teaching in the School of Medicine, University of Oklahoma, for 11 years, was conducting a large private practice in diseases of the chest and was author of several medical articles.

He was born in Leitchfield, Kentucky, on February 9, 1875. During his childhood it was the family physician's "fine character, high place in the community, hold upon the hearts of the people, unselfish devotion to duty, obvious wisdom and unchallenged authority" that influenced Lewis to study medicine. He went to Georgetown Academy, Kentucky, for premedical work and graduated in 1898. Three years later he received the degree of Doctor of Medicine from the University of Louisville. After investigating locations to establish private practice in Alabama, he decided to go to Oklahoma (1901) where he opened an office with a schoolmate at Chichasha. The first two months brought only two dollars in fees. They then traveled to Jet to take over the practice of a physician reaching age retirement. Lewis still owed $1100 on his medical education. Approximately six years later, after a successful term of practice in Jet he located in Oklahoma City. Soon after marriage to Miss Mary Davis Christian on April 27, 1909, he and Mrs. Moorman went to Europe for postgraduate study. Here his time was spent mostly on wards and in postmortem rooms where he had the first chance to correlate symptoms with pathology. He came under the guidance of Ghon, Pirquet, and other eminent physicians. On returning to Oklahoma City he resumed the practice of medicine with special emphasis on tuberculosis and other diseases of the chest.

Almost from the start his practice, teaching and writing were of such quality that it was obvious he was destined to attain high positions and worldwide recognition.

He was a superb teacher in the University of Oklahoma School of Medicine and advanced in rank to a full professorship in medicine. In 1931 he was made dean of the medical school, but he continued to teach. On retirement he became emeritus professor but still taught history of medicine.

As a writer Dr. Moorman was unexcelled. His first paper, entitled, "An Inspiration From a Chapter in the History of Tuberculosis," was published in the *Journal of the Oklahoma State Medical Association* in July, 1916. Subsequently he published more than 100 articles in addition to approximately 1000 editorials and special items, and he was still writing at the time of his final illness. Some manuscripts are still in press, one of which is entitled "Medicine on the March."

He contributed chapters to systems of medicine and wrote books. His book entitled *Tuberculosis and Genius* (1940) which consists of excellent biographical

sketches of 10 world-renowned persons who had suffered from tuberculosis was dedicated to "All who have suffered and striven courageously for victory over disease and death." A Spanish edition of this book was published in 1945, and now a French translation is being considered.

In 1951 a book appeared under the title *Pioneer Doctor*. This autobiography delineates the evolution of medicine as he saw it practiced by the family physician as a child through every important event to 1951. The doctor-family relationship which he portrays so beautifully has played a far more significant role in American medicine than is generally appreciated.

In 1951 few physicians were alive who possessed so much information gained largely from actual experience and who had made such fine contributions in so many ways as Dr. Lewis Moorman. Therefore, it was particularly fitting and indeed fortunate for people everywhere that he wrote *Pioneer Doctor*. His fine character and philosophy of life are revealed throughout this volume.

His writings attracted so much attention that he was in demand on numerous editorial boards. For some time he served on the board of the *Journal of the Outdoor Life*. From 1939 to 1948 he was on the editorial board of the *American Review of Tuberculosis*. He was United States corresponding member of the editorial board of *Tuberculosis Review and Abstracts of Current Literature*, London, England, since 1950. He had served as president of the American Medical Writers Association and was a member of the World Medical Editors Association participating in the meeting in Athens, Greece, in October, 1952. For some time he was editor of the Oklahoma County Medical Society Bulletin. In 1941 he was elected to the editorial board of the *Oklahoma State Medical Association Journal* and two years later became editor-in-chief, in which capacity he served until his death.

In medical organizations he was a long-time leader. He was elected to the secretaryship of the Oklahoma County Medical Society in 1908, was president in 1918 and had been secretary-treasurer since 1941. In 1920 he was president of the Oklahoma State Medical Association and in 1922 the Oklahoma City Academy of Medicine. He was a member of the Board of Directors, Oklahoma Medical Research Foundation, since 1946 and served on its executive committee.

In 1932 he was president of Southern Medical Association and in 1937 vice-president of the American Sanatorium Association. He was vice-president of the American Clinical and Climatological Association in 1947. He was certified by the American Board of Internal Medicine and was a Fellow of the American College of Physicians since 1920.

In tuberculosis and public health Dr. Moorman also reached the top rung of the ladder. He was president of the Oklahoma County Health Association from 1918 to 1947, then elected honorary president. For a number of years he was president of the Oklahoma State Tuberculosis Association and was elected to the presidency of this organization in 1944, having already served as president of its medical section, the American Trudeau Society, in 1941.

In the practice of medicine he had a tremendous following. Hospital beds were not available for his tuberculous patients in the earlier years of his career. Therefore, he established the Farm Sanatorium in 1914 which was the first private sanatorium in Oklahoma. This institution was in continuous operation for the next third of a century. A day or so with Dr. Moorman in his office and in his sanatorium was an education in itself. Such an experience enabled one to better know why he was so often referred to as the beloved physician.

Having practiced medicine in Indian Territory Dr. Moorman developed an understanding of and love for American Indians. In later years he became influential in efforts to solve their tuberculosis problem. In a conference on tuberculosis among Indians during the meeting of the National Tuberculosis Association in 1952 his discussion revealed his extensive knowledge of the subject and his burning desire to have the problem solved. He strongly supported the plan to have tuberculosis among Indians transferred to the United States Public Health Service so adequate hospital facilities could be provided for them.

When a group of five physicians was sent by the Department of the Interior as representatives of the American Medical Association to study medical condi-

tions among the Navajo-Hopi Indians, Dr. Moorman was chosen as chairman. He prepared a most comprehensive report, published in the *Journal of the American Medical Association* on February 5, 1949, which contains the following statement: "The diseases afflicting the Navajo-Hopi Indians with few exceptions differ from those found in the white population only in degree, and this difference is due to environmental conditions, want of education and adequate medical care rather than to innate racial factors and influences.

"For example, the meager statistical data regarding tuberculosis indicate that the mortality from this disease is approximately 10 times that in the general population. Yet its course in the Indian closely parallels that in the white man. This being true, we must conclude that the differences must be due to provocative factors in the environment, including faulty nutrition, physical hardships, overcrowding in the hogan and inadequate medical care, which implies the lack of effective case finding, the failure to break contacts, imperfect methods of management and the lack of sanatorium care with all the modern phases of collapse therapy and eternal vigilance through adequate follow-up service."

Dr. Moorman was a most sincere and calm physician, but he had a delightful sense of humor. His close friends recognized from a characteristic twinkle that a choice story was about to be told.

Dr. Moorman took extreme pride in his home and family. He and Mrs. Moorman provided their children with all educational and other advantages during infancy, childhood, and young adulthood. They in turn have their own families. Mrs. Charles D. Tuller resides in Atlanta, Georgia, Mrs. George Grant and Lewis J. Moorman, Jr. live in San Antonio, Texas. The dedication page of Dr. Moorman's last book is, "To my grandchildren, the fifth generation of my time."

Dr. Moorman was a good fighter for any worthy cause. In 1929 while Mrs. Leslie Gray, representing the National Y.W.C.A. Board was stationed in Oklahoma City to raise $750,000 for the construction of a local YWCA building, Dr. Moorman was an ardent supporter and worker in the campaign. While it was in progress, I was participating in a series of tuberculosis meetings which he had arranged. One afternoon an editorial appeared in a daily newspaper in which the medical profession was severely condemned for not contributing to the YWCA building fund as freely as the editor would like. Late that evening Dr. Moorman came to the hotel, read the editorial aloud, then took from his pocket a reply. Already he had checked with the various free clinics where physicians contributed their services and other professional work which physicians had donated to the needy during the past year. This totaled $500,000. He had dispassionately included these and more facts in editorial form. The next morning he demanded that the editor publish this material, and it appeared on the editorial page of the afternoon paper.

With the full realization that his span was drawing to a close his fine philosophy of life continued, and he worked as enthusiastically and as fervently as ever. On December 23, 1953, he wrote: "You may be interested to know that I am now busily engaged in search for data on the early day history of medicine in Oklahoma. We are planning a two volume history and I am going to try to do the one on Indian medicine and the white man's medicine in the early days. The second volume will deal with modern medicine." On January 14, 1954, he wrote: "Regardless of the matter of funds, I think that I have two or three years of research ahead of me for the history of medicine in Oklahoma."

He was also assembling data for a volume of biographical sketches of prominent physicians who had suffered from tuberculosis.

He rarely missed an annual meeting of the National Tuberculosis Association. However, on inquiring for him at the golden anniversary meeting in May it was learned that his health would not permit attendance. The condition proved to be malignant from which he died on August 2, 1954, in St. Anthony Hospital where he had long been a prominent staff member and had been honorary member since 1950. On September 10, 1954, at the meeting of the Southern Tuberculosis Conference in Atlanta, Georgia, Dr. Moorman was awarded, posthumously, the first annual award established by this Conference.

Lewis Moorman's life was so lived that in all future generations of physicians none can do better than to emulate him.

J. Arthur Myers

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Resident Fellows

The Committee on Resident Fellowships in Chest Diseases of the American College of Chest Physicians has recently received and approved applications for residencies from physicians whose biographical data appears below. In accordance with regulations established by the United States Department of State, these physicians will return to their respective countries at the completion of the prescribed training period.

The Committee on Resident Fellowships will be pleased to forward for your consideration any applications which you may wish to review. Please address your inquiries to: Committee on Resident Fellowships, American College of Chest Physicians, 112 East Chestnut Street, Chicago 11, Illinois.

YHP, Seoul, Korea, age 43, married; interested in further training in tuberculosis; Medical school: Seoul Medical College; Internship: Seoul Medical College; Residencies: Seoul Imperial Medical University Hospital, Sunchon Medical College Hospital; presently in private practice; speaks English well, desires 1-2 years training; available now.

GPL, Namur, Belgium, age 29, married; interested in thoracic surgery; Premedical school: Christian Brothers; Medical school: University of Louvain; Internship: St. Pierre Hospital; Postgraduate training: staff, Mining company, Belgian Congo; speaks French, Flemish, English, desires three years' training.

LPP, Quito, Ecuador, age 30, single; interested in medical aspects of chest diseases; Premedical school: Central University, Quito; Medical school: Central University; Internship; Sanatorio P. A. Suarez; presently staff physician, Sanatorio P. A. Suarez; speaks Spanish, English, desires 1-2 years training.

TSF, Tainan, Formosa, age 34, married; interested in additional thoracic surgery training; Premedical school: Yu Hsi High Middle School; Medical school: National Defense Medical Center; Internship: Army Medical College; Residencies: Air Force Hospital, Tsingtao General Hospital; Presently: Chief Surgeon, Army Hospital; speaks Chinese, German, English, desires at least one year training.

JHA, Jerusalem, Jordan, age 30, single; interested in pathology and clinical aspects of tuberculosis; Premedical school: Bishop Gobat School; Medical school: American University, (Beirut, Lebanon); Internship and residency: Sanatorium Liban (Lebanon); Presently: Senior Medical Officer, Tuberculosis Control, UNRWA; speaks French, English, desires 1-2 years training.

NHO, Istanbul, Turkey, age 33, single; interested in thoracic surgery; Medical school: Medical Faculty of the University of Istanbul; Internship; Military Medical Academy; Postgraduate training: Surgeon, Air Force Hospital; speaks Turkish, German and English, desires two years training.

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CALENDAR OF EVENTS

NATIONAL AND INTERNATIONAL MEETINGS

21st Annual Meeting, American College of Chest Physicians
Ambassador Hotel, Atlantic City, New Jersey, June 2-5, 1955

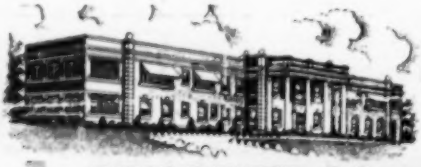
Fourth International Congress on Diseases of the Chest
Germany, 1956

POSTGRADUATE COURSE

8th Annual Postgraduate Course on Diseases of the Chest
Bellevue-Stratford Hotel, Philadelphia, March 7-11, 1954

CHAPTER MEETING

Clinical Session, New York State Chapter
New York City, February 17, 1955



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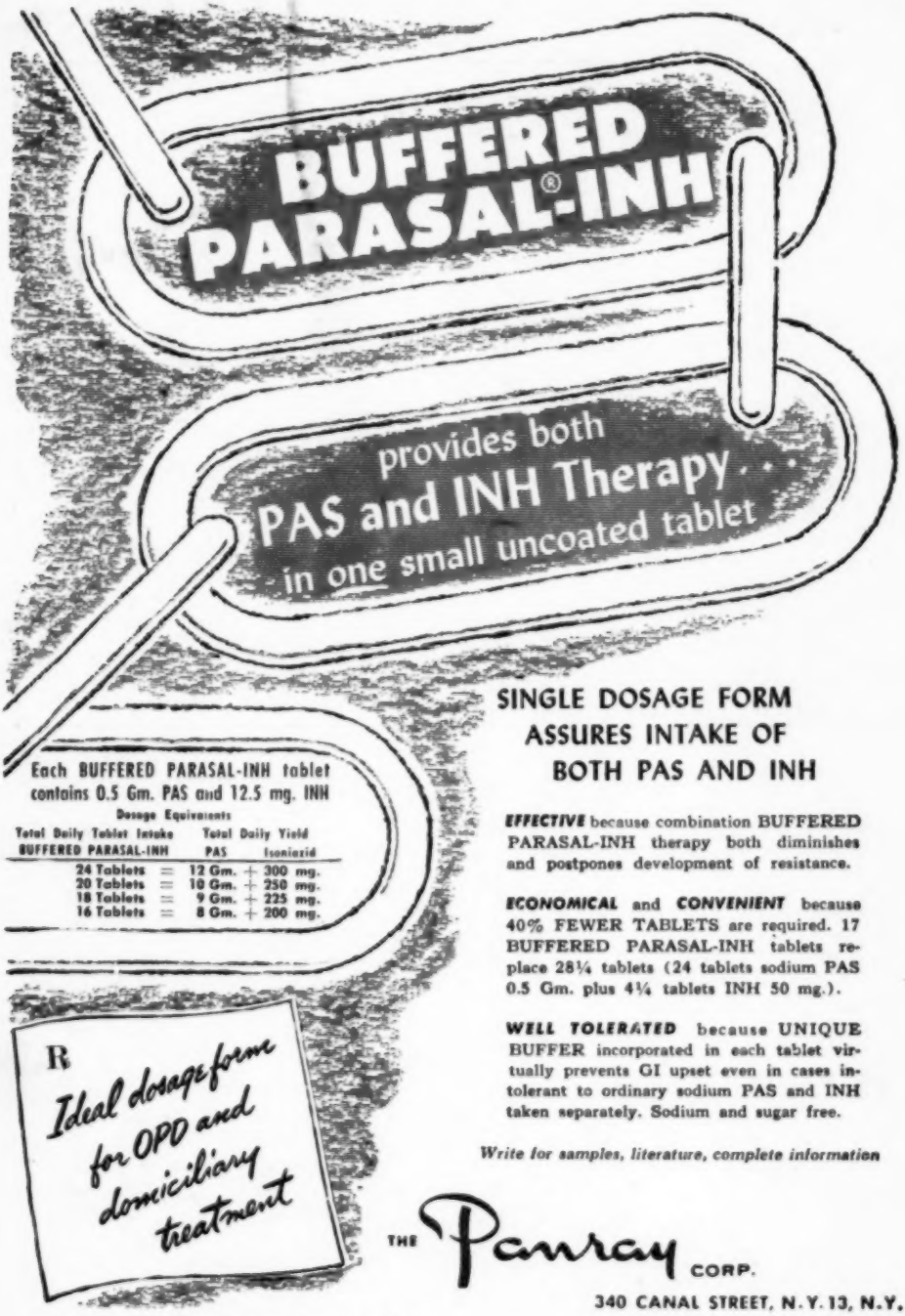

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